Doc. No. TQ0870003-OM002

Operation Manual

PRODUCT NAME

Simple Absolute Controller / Step Motor (Servo 24 VDC)

MODEL / Series / Product Number

LECP7□-XB3 Series

SMC Corporation

Contents

LECP7 Series / Controller
1. Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions are categorized into three groups, "Caution", "Warning" and "Danger" depending on the level of hazard and damage, and the degree of emergency. They are all important notes for safety and must be followed in addition to International Standards (ISO/ IEC), Japan Industrial Standards (JIS)[*1)] and other safety regulations[*2)].

*1) ISO 4414: Pneumatic fluid power -- General rules relating to systems
ISO 4413: Hydraulic fluid power -- General rules relating to systems
IEC 60204-1: Safety of machinery -- Electrical equipment of machines (Part 1: General requirements)
ISO 10218-1992: Manipulating industrial robots -- Safety
JIS B 8370: Pneumatic fluid power - General rules relating to systems
JIS B 8361: Hydraulic fluid power - General rules relating to systems
JIS B 9960-1: Safety of machinery - Electrical equipment of machines (Part 1: General requirements)
JIS B 8433-1993: Manipulating industrial robots - Safety, etc

*2) Labor Safety and Sanitation Law, etc.

Caution	Caution indicates a hazard with a low level of risk. Which, if not avoided, could result in minor or moderate injury.
Warning	Warning indicates a hazard with a medium level of risk. Which, if not avoided, could result in death or serious injury.
Danger	Danger indicates a hazard with a high level of risk. Which, if not avoided, will result in death or serious injury.

Warning

(1) The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results.

The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product.

This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

(2) Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly.

The assembly, operation and maintenance of machines or equipment must be performed by an operator who is appropriately trained and experienced.

(3) Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent dropping of driven objects or run-away of machinery/equipment have been confirmed.
2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

(4) Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.

1. Conditions and environments outside of the given specifications, or use outdoors or in a location exposed to direct sunlight.
2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.
3. An application which could have negative effects on people, property, or animals requiring special safety analysis.
4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation. Check the product regularly in order to confirm normal operation.

LECP7 Series / Controller
1. Safety Instructions

⚠Caution

The product is provided for use in manufacturing industries.
The product herein described is basically provided for peaceful use in manufacturing industries.
If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.
If anything is unclear, contact your nearest sales branch.

Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”.
Read and accept them before using the product.

[Limited Warranty and Disclaimer]

(1) The warranty period of the product is 1 year in service or within 1.5 years after the product is delivered.*
Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.

(2) For any failure or damage reported within the warranty period, which is clearly our responsibility, a replacement product or necessary parts will be provided.
This limited warranty applies only to SMC product independently, and not to any other damage incurred due to the failure of the product.

(3) Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

*** Vacuum pads are excluded from this 1 year warranty.**
A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.
Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

[Compliance Requirements]

This product has been confirmed to comply with Japanese laws only.

When the product is exported, strictly follow all national and regional laws and regulations in Japan and the countries it is exported to.

This product uses a nickel-metal hydride battery.

Under UN restrictions, nickel metal hydride batteries are classed as dangerous (Class 9) for sea transport only. *This product is a non-dangerous article for sea transport (as of August 2012).

When transporting a nickel-metal hydride battery or equipment containing nickel-metal hydride battery by a means subject to the UN Regulations, it is necessary to satisfy the UN Recommendations on the Transport of Dangerous Goods, Technical Instructions (ICAO-TI) of the International Civil Aviation Organization (ICAO), and International Marine Dangerous Goods Code (IMDG Code) of the International Maritime Organization. When the product is transported by the user, it is necessary for the user themselves to confirm and conform to the latest standards and laws of the corresponding country related to transportation.

This product is not sold by SMC subsidiaries overseas.

2. Product Outline

2.1 Outline of absolute controller

- About this product

  This product is a simple absolute type controller. The battery retains (stores) position data after loss of power.

  Applicable for incremental type encoder.

- Actuator control

  Positioning operation and operation at a specific speed and force for the actuator are possible by controlling the Step motor (servo 24 VDC).

- Specified force operation

  Control the pushing force or the pressing force of the actuator.

- Separated power supply

  The power supply is separated into the motor power and the control power. Therefore, even when the motor power is off, if the control power is on, the position information from the encoder will be maintained and the serial communication and parallel I/O control are still available.

- Return to origin

  Return the actuator to the home position by sending a single signal to a dedicated terminal.

- Alarm detection function

  Abnormal conditions are self-detected. Alarms are displayed by LEDs on the controller and abnormal conditions are output to the outside by the parallel I/O terminal.

  Alarm history can be stored in the memory in the controller. (Max. 8 records from the latest)

- 64 points positioning / pushing are available

  Control the actuator according to the step data specified by the input of parallel I/O.

  It is possible to set up various parameters for each operation pattern.

- Area output

  The area output terminal will be activated if the actuator position is within the range specified by “Area 1” and “Area 2” in the step data.

- Data input method

  It is possible to perform parameter setup, status monitoring, trial run and alarm reset via the serial communication with a PC installed with the controller setting software or the teaching box.

- Easy mode and Normal mode

  There are two available modes for the controller setting software and the teaching box. In Easy mode, you can start the operation by only setting the speed, position, etc. In Normal mode, further detailed setup can be performed.

⚠ Caution

[Cautions when using this controller for the first time]

(1) Install the battery

Please refer to “16.2 Replacement of Battery”.

(2) Reset the alarm

Two alarms will be generated when power is applied to the controller for the first time and/or when power is applied after battery replacement.

The “Absolute encoder ID does not match controller data” Alarm (code: 1-153) is generated first. Reset the alarm. (The absolute ID in the absolute controller will be initialized.)

After resetting the first alarm, the alarms listed below are generated.

Reset the second alarm. (It is dependent on the condition of the battery.)

- “Low Battery voltage” Alarm (Code: -107) --- Battery voltage is low
- “Abnormal absolute encoder” Alarm (Code: -152) --- Encoder signal counting error.
- “Absolute encoder cable is not connected to the controller.” Alarm (Code: -154) --- Encoder signal counting error.

(3) Continuous charging is required for at least 72 hours

When power is applied to this controller for the first time, maintain a continuous supply of power for at least 72 hours to fully charge the battery.

(4) Return to origin position is necessary in the following conditions,

1) When supplying power for the first time

2) When alarm (Group D) is generated when the power is supplied following initial power application

(e.g.) Battery is discharged

The actuator is operated by an external force while the power supply is interrupted, exceeding the maximum rotation of the motor during power interruption.

3) When an Alarm (Group E) is generated, and the alarm is cleared by reapplying power.

⚠ Caution

Please keep this manual safe for future use. It will be necessary to refer to this manual along with the teaching box and the setting software manuals at installation and fault finding.

2.2 How to Order

The part number construction for this product is as follows:

L E C P 7 N □ □ − □ − X B 3

Electric equipment

Controller

Corresponding motor

P	Step motor (servo 24 VDC)

Controller

7	Absolute /Step 64 points

Parallel I/O type

N	NPN type
P	PNP type

I/O cable length

NIL	None
1	1.5m
3	3m
5	5m

Actuator Model

(Enter from the actuator model "LE" to ”stroke”)
e.g.: LEHZ10LK2-4AF-R1FN1D
Enter “LEHZ10LK2-4”

DIN rail

NIL	None
D	DIN rail

⚠ Caution

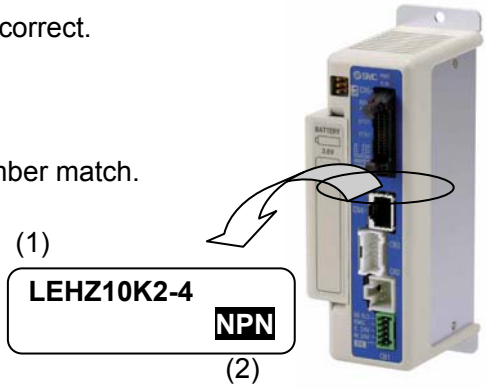
Single controllers are also shipped after setting the actuator specification parameters.

Confirm the combination of the controller and the actuator is correct.

<Check the following before use.>

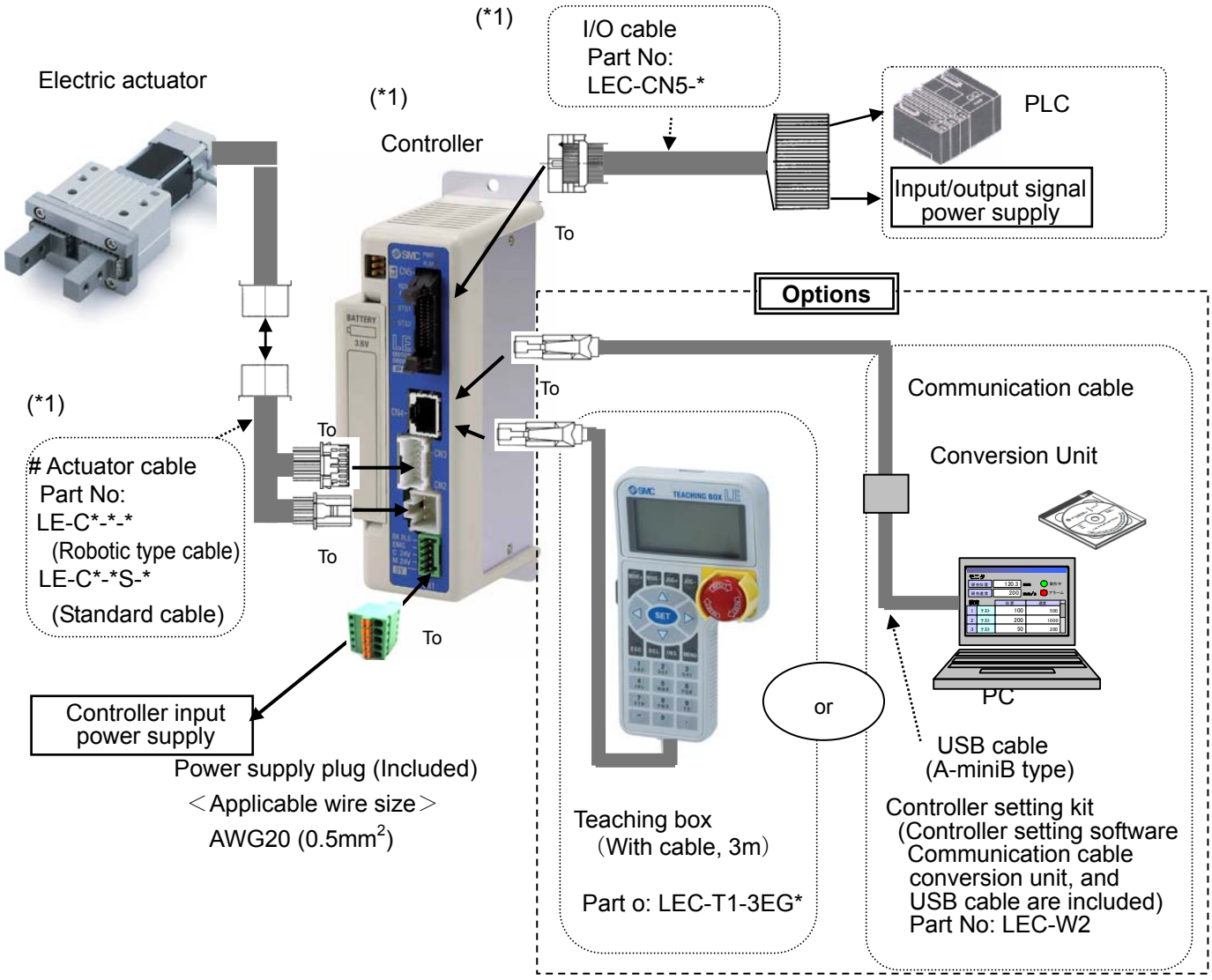
(1) Check if the actuator label and the actuator product number match.

(2) Parallel input / output (NPN, PNP)



2.3 Product configuration

The product configuration of this controller is as follows.



(*1) These items are included when ordered using the part number for an actuator set.

(*2) Latest version of the controller setting software must be used.

Upgrade software can be downloaded from SMC website. http://www.smcworld.com/

⚠Warning

Refer to 4. External Wiring Diagram.
Refer to 14. Wiring of cables / Common precautions.

Connect to the personal computer communication cable with the USB port cable via the conversion unit.
Do not connect the teaching box directly to the personal computer.
Do not use LAN cable to connect to the controller, as this may cause damage to the personal computer.

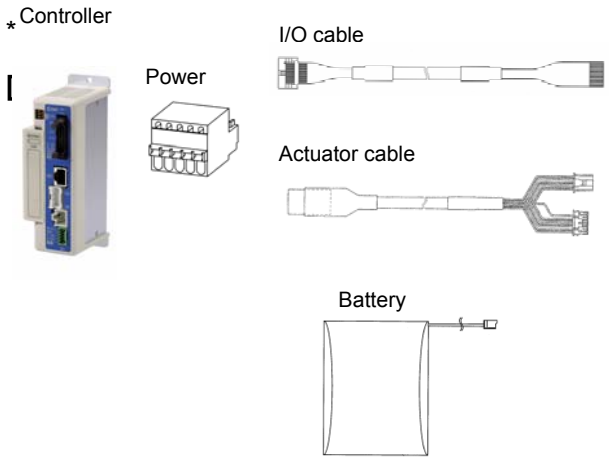
2.4 Start up Procedures

Install, wire, set and operate the controller referring to the procedure below when the product is used for the first time.

(1) Checking the contents of the package

After unpacking everything, check the description on the label to identify the controller and the number of accessories.

Product name	Quantity
Controller (LECP7***-*)	1 pc.
Power supply plug	1 pc.
I/O cable* (LEC-CN5-*)	1 pc.
Actuator*	1 pc.
Actuator cable* (LE-CP-*-*-*)	1 pc.
Battery（LE-BP-X22）	1 pc.



*These items are included when ordered using the part number for an actuator set.

[Options]

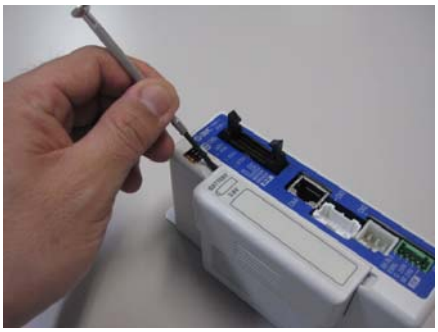
Teaching box (Product number: LEC-T1-3□G□)

Controller setting kit (Product model No.: LEC-W2)
[Controller setting software, communication cable, USB cable and conversion unit are included.]

*If parts are missing or damaged, please contact our distributor.

(2) Installation of battery pack

1） Detach the battery case from the controller.
Use a small flathead screwdriver to carefully lift the battery case out of the controller.



2） Disconnect the battery connector from the circuit board.

3） Connect the replacement battery to the circuit board.

4） When installing the battery case, ensure that the cable is not trapped between the battery case and the controller housing .

5）

Carefully push the battery case into the controller housing until fully installed. Confirm the battery case does not move.

6） Please refer to "8.1 Charging of the battery".

(3) Installation

Please refer to “3.4 How to install ”

(4) Wiring and Connection

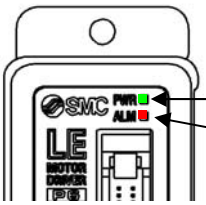
Connect cables, etc. to the connectors (CN1 to CN5) of the controller.

Please refer to the “4 External Wiring Diagram ” for the wiring of the connectors.

Connector

(5) Power ON alarm (error)

Ensure the stop is not activated and then supply 24VDC power.



LED	Colour	Condition
POWER	Green	Normal
ALARM	Red	Alarm is generated

Controller

If the green [PWR] LED is on, the controller is in the normal condition.

If the red [ALM] LED on the front of the controller is on, the alarm has been triggered .

⚠Caution

In case of alarm (error) condition:

Connect a PC or the teaching box to the CN4 serial I/O connector and check the details of the alarm. Then, remove the cause of the error referring to **"13. Alarm Detection."**

* Please refer to the manuals of the controller setting software or the teaching box for details of the alarms.

(6) Operation pattern setting

Set up the operation pattern (step data, basic parameters and return to origin parameters) to specify the target position, speed, etc. by using a PC (with the controller setting software) or the teaching box.

■ PC (Normal mode)

■ Teaching box

Please refer to the manuals of the controller setting software or the teaching box for how to set up the operation pattern.

(7) Trial run (actuator adjustment)

Please refer to the manuals of the controller setting software or the teaching box manual for how to perform a trial run.

3. Product Specifications

3.1 Basic specifications

Basic specifications of the product.

Item	Specifications
Compatible motor	Step motor (servo 24 VDC)
Power supply specification Note 1)	Power supply voltage: 24VDC±10％ Maximum current consumption: Rated 3.2A (Peak 5A) Note 2) [Includes the motor power supply, control power supply, stop, unlocking]
Parallel input	Input 11 points (Photo coupler insulation)
Parallel output	Output 13 points (Photo coupler insulation)
Compatible encoder	Incremental A/B phase (800 pulse/rev)
Serial communication	RS485 (Complies with Modbus protocol)
Memory	EEPROM
LED display	PWR, ALM, RDY/ALM, STS1, STS2
Lock Control	Forced lock-release terminal
Cable length	I/O cable: 5m or less Actuator cable: 20m or less
Battery	Nickel-Metal Hydride secondary battery 3.6V Battery Charge time: 72 hours
Recommended lifetime for battery replacement	2 years Note 3)
Battery backup hold time: After the power supply is cut Default setting 20 days (4 level settings) Note 4) , Note 5)	20 days (When the maximum manual rotation of the motor is set to 100rpm or less) 10 days (When the maximum manual rotation of the motor is set to 200rpm or less) 5 days (When the maximum manual rotation of the motor is set to 400rpm or less) 2 days (When the maximum manual rotation of the motor is set to 800rpm or less)
Cooling method	Natural air cooling
Operating temperature range Note 6)	Screw mount type : 0 to 40°C (No freezing) DIN rail mount type : 0 to 30°C (No freezing)
Operating humidity range	90%RH or less (No condensation)
Storage temperature range	0 to 40°C (No freezing)
Storage humidity range	90%RH or less (No condensation) (Note 6)
Insulation resistance	Between the housing and SG terminal: 50MΩ（500VDC）
Weight with Battery	410g (Screw mount type) 430g (DIN rail mount type)

Note 1) Do not use a power supply with “inrush-current control” for the controller power supply.

Note 2) Power consumption depends on actuator. Refer to the specification of actuator for details.

Note 3) Based on average use of 8 hrs/day at a temperature of 20°C.

The lifetime time of the battery is reduced when the operating temperature rises, because the performance of the battery deteriorates.

Note 4) Battery back up hold time at 20°C (reference).

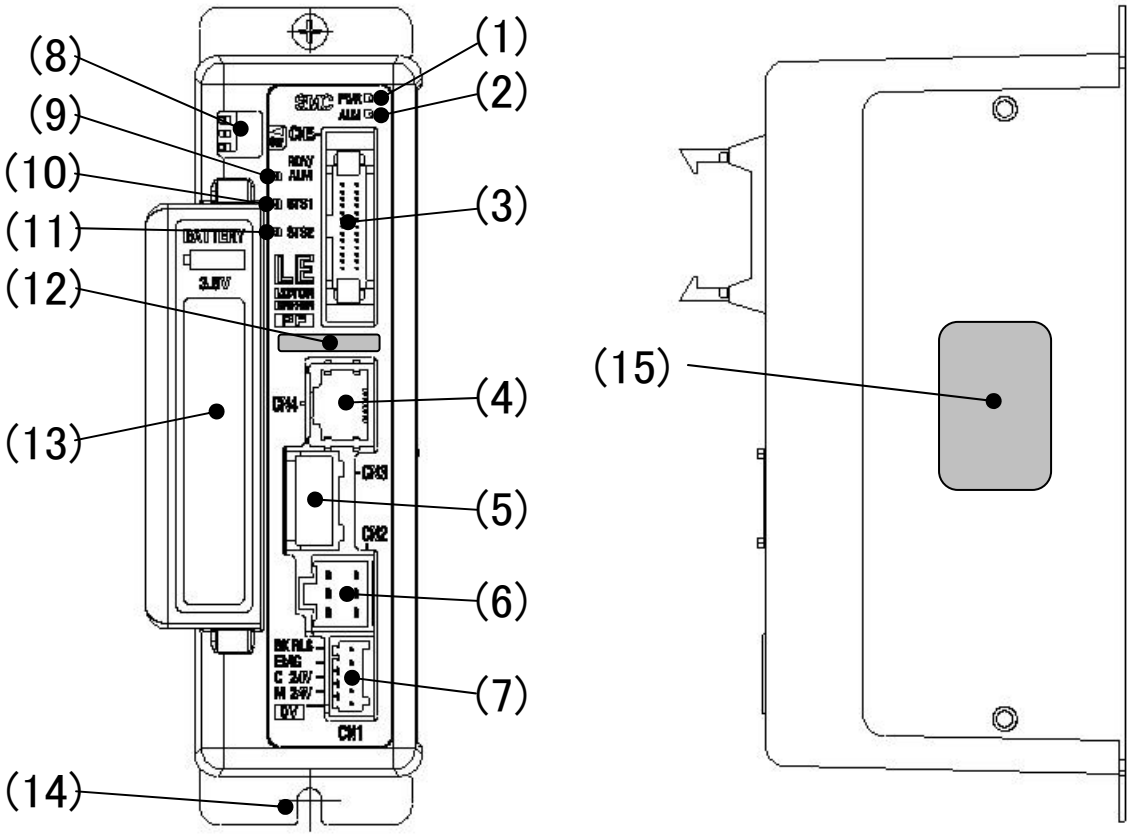
After the power supply is cut, the battery back up hold time is reduced when the operating temperature rises.

Note 5) The time to monitor the motor/encoder position using the battery back up when the power supply is cut, the duration depends on the set value of the maximum manual operation cycle rotation speed (rpm) when the power supply is cut.

Note 6) Recommended: 20°C.

3.2 Parts description

The detailed descriptions of each part are as follows:



No.	Label	Name	Description
1	PWR	Power supply LED (Green)	Power supply ON / No alarm: Solid green light Writing data (step data, parameter) / Flashing green light **⚠ Caution** Do not turn off the input power supply for the controller or disconnect and connect the cable while the data is being written (power supply LED (green) flashes). *Possibility of incorrect/corrupted data (step data, parameter)
2	ALM	Power supply LED (Red)	Power supply ON / With alarm: Solid red light
3	CN5	Parallel I/O Connector (26 pins)	Connect to PLC using I/O cable. (11 points input and COM terminal, 13 points output and COM terminal)
4	CN4	Serial I/O Connector (8 pins)	Connect to the teaching box, PC etc.
5	CN3	Encoder Connector (16 pins)	Connect to the actuator cable.
6	CN2	Motor Power Connector (6 pins)	

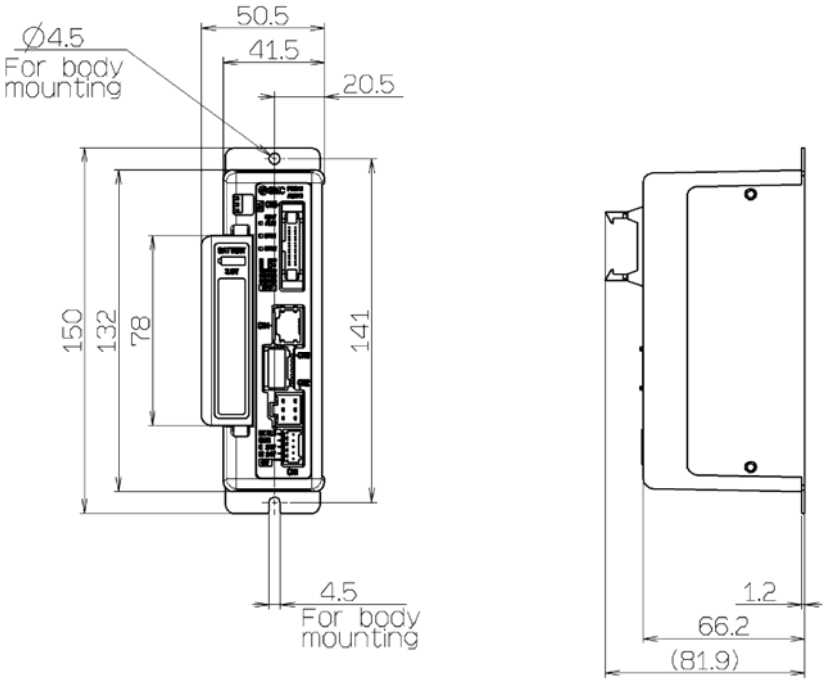
No.	Label	Name	Description
7	CN1	Power Supply Connector (5 pins)	Connect to the controller input power supply (DC24V) using the power supply plug. Lock release (+) Stop signal (+) Control power (+) Motor power (+) Common power (-)
8	SW	Backup period set switch	Sets the battery backup hold time.
9	RDY/ ALM	Ready / Alarm LED	No absolute circuit alarm: Green light on Absolute circuit alarm: Red light on
10	STS1	Status LED	Normal: Green light On; Reset: Orange light On; Absolute error: Red light On
11	STS2	Battery charge LED	Fully charged (72 hours continuous charge): Green light On Charging: Orange light On Not connected (including discharged state): Red light On
12	—	Applicable actuator model number label	Applicable actuator description
13	—	Battery case	Battery is housed in the case Write the battery purchase date in the column. Recommended lifetime for battery replacement is 2 years Note 1) (Also, write the battery purchase date when the battery is replaced).
14	—	FG	Functional ground: When mounting the controller connect the grounding cable and tighten the screws
15	—	Controller Model number label	Controller description

Note 1) Based on average use of 8 hrs/day at a temperature of 20°C
The lifetime time of the battery is reduced when the operating temperature rises, because the performance of the battery deteriorates.

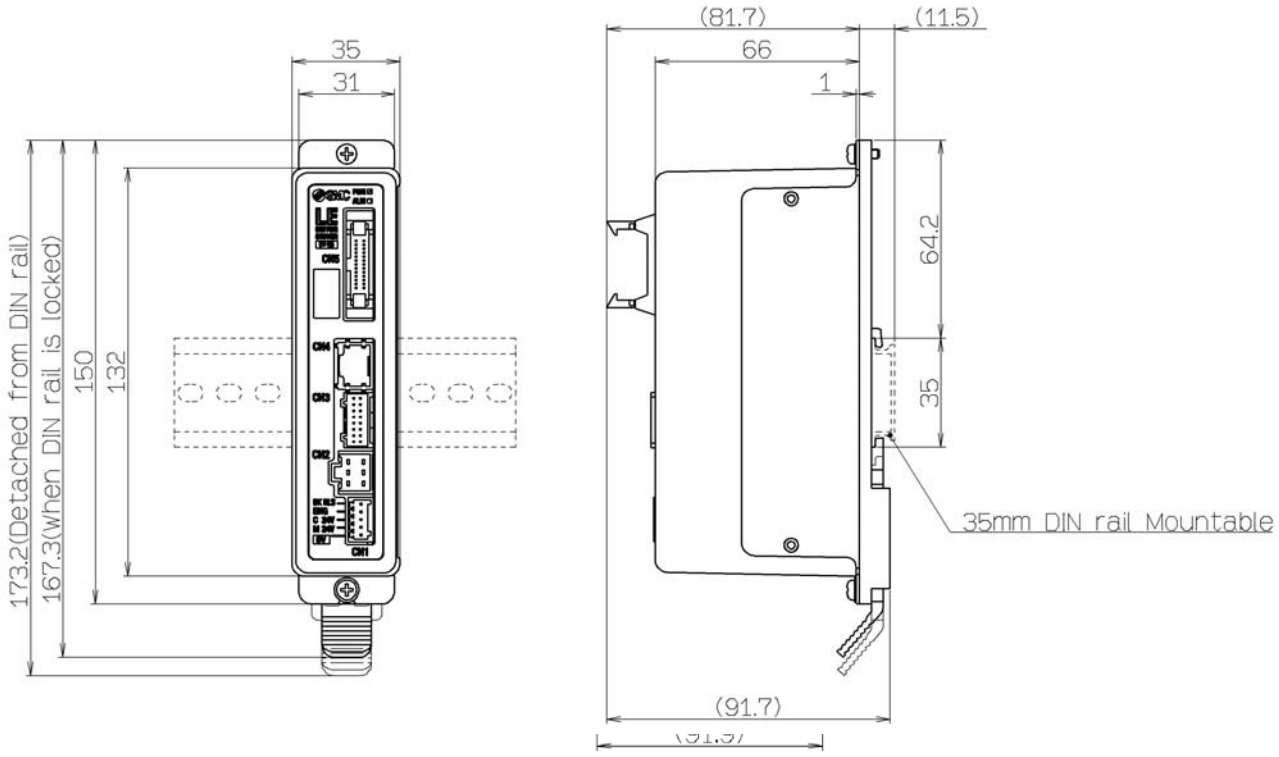
3.3 Outside dimension diagram

The appearance of this product is as shown in the diagram below:

(1) Screw mount type (LECP7-*)**



(2) DIN rail mount type (LECP7D-*)**



3.4 How to install

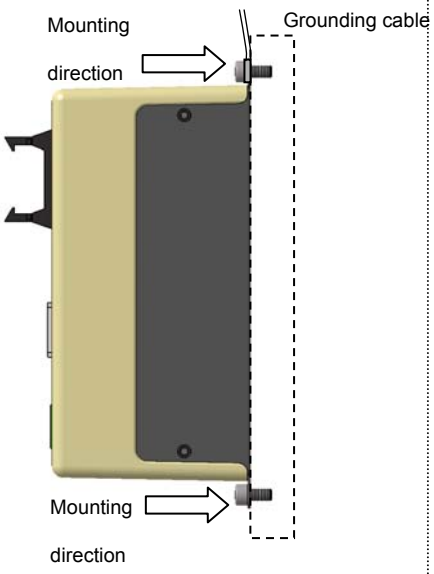
(1) How to install

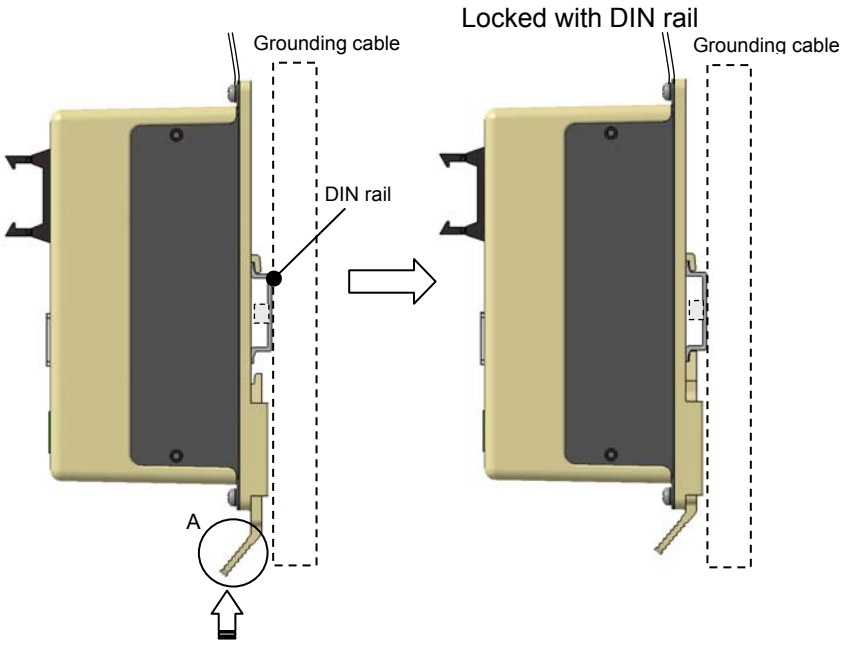
There are two types of controllers; screw mount type and DIN rail mount type.

The instructions below show how to install each type:

(1) Screw mount type (LECP7-*)**

(Mounting with two M4 screws)

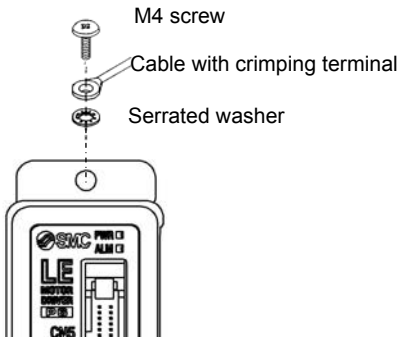




Hook the controller on the DIN rail and press lever A in the direction of the arrow to lock it.

(2) Ground wire connection

Tighten the bolt with the nut when mounting the ground cable as shown below.



Controller

⚠ Caution

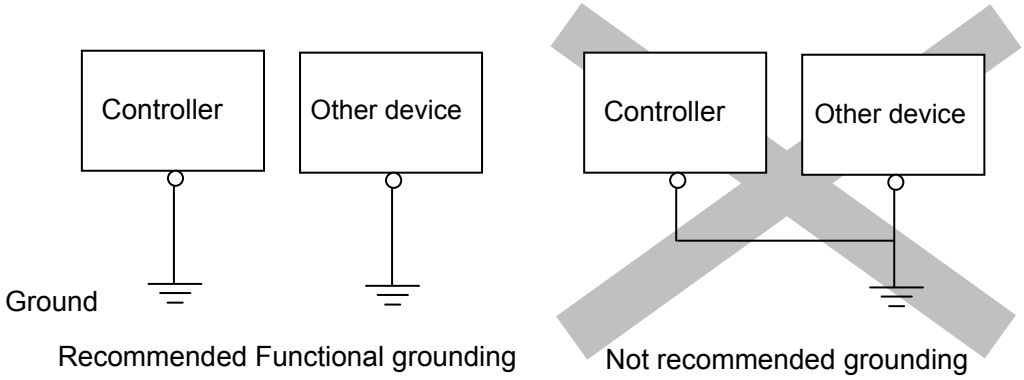
The M4 screw, cable with crimping terminal, and serrated washer should be obtained separately.

Ground the controller to shield it from electrical noise.

⚠ Caution

(1) The earthing should be the dedicated grounding point. It should be a functional ground with less than 100 Ω resistance.

(2) The cross section of the grounding wire should be greater than 2mm^2.
The ground point should be near this controller to make the wire length shorter.



Recommended Functional grounding

Not recommended grounding

(3) Installation location

Select the size of the control cabinet and the controller mounting type so that the surrounding temperature of the controller is 40°C or less for screw mounting type and 30°C or less for DIN rail mounting type (20°C recommended).

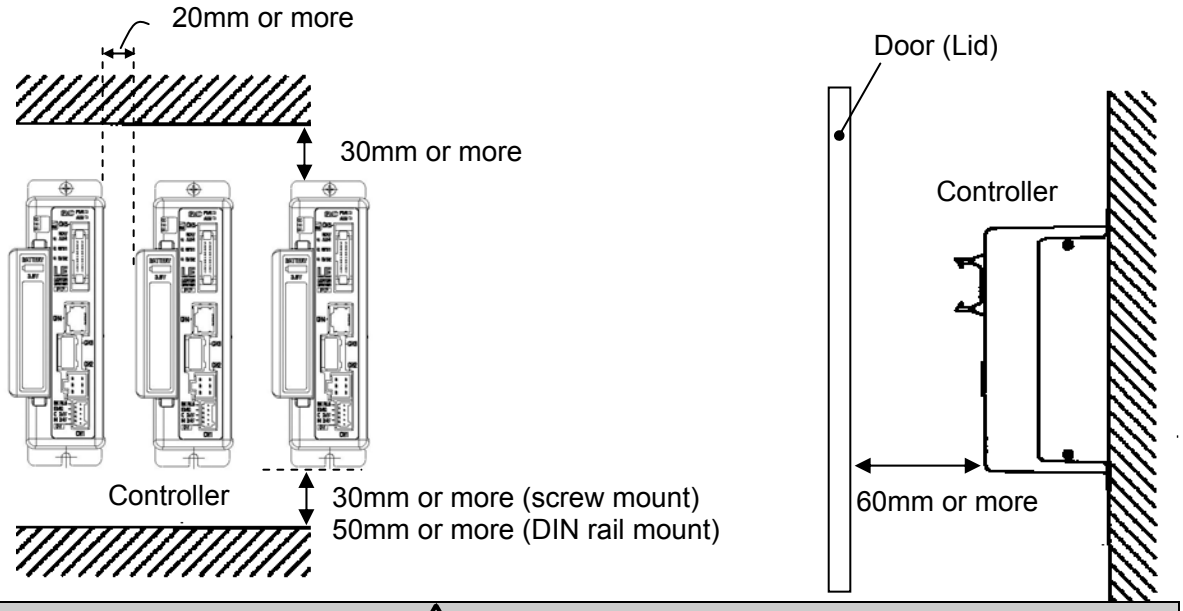
Mount the controller vertically on the panel with 30mm or more (screw mounting type) and 50mm or more (DIN rail mounting type) of space at the top and bottom of the controller.

When installing more than one controller in parallel, allow a space of 20mm or more between the controllers.

Allow 60mm or more of space between the front of the controller and the cover of the control cabinet to allow access to the connectors.

Leave enough space between the controllers so that the operating temperatures of the controllers stay within the specification range.

Avoid mounting the controllers on a panel where sources of vibration such as large sized electromagnetic contactors or circuit fuse breakers, are also mounted.



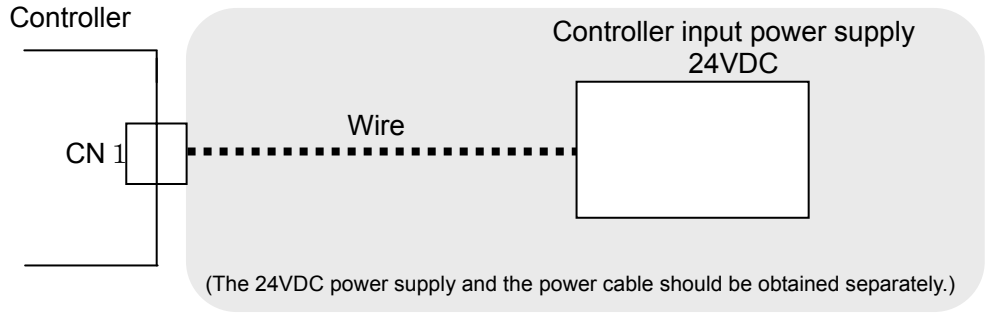
⚠ Caution

Install the controller on a flat surface. Excessive pressure applied to the housing will damage the controller.

4. External Wiring Diagram

The typical connections for each connector of this controller (CN1 to CN5) are as shown below.

4.1 CN1: Power connector



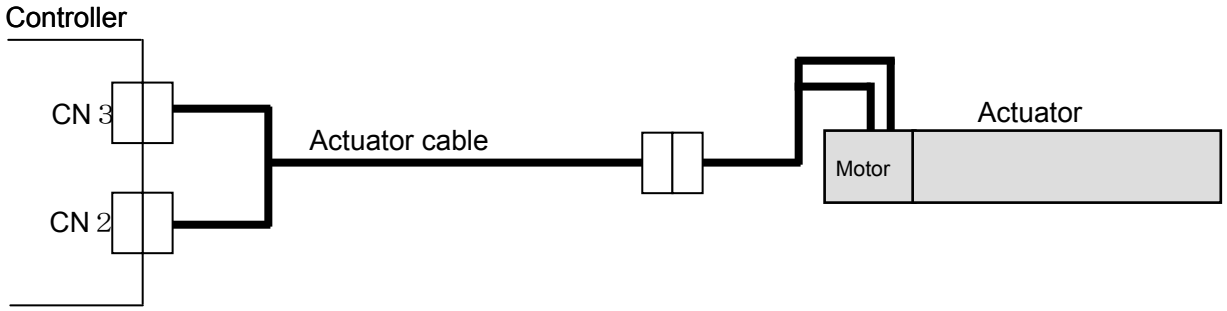
* Please refer to **"5. CN1: Power supply plug "** for how to wire the CN1 connector.

⚠Caution

Do not use a power supply with "inrush-current control" for the controller power supply.

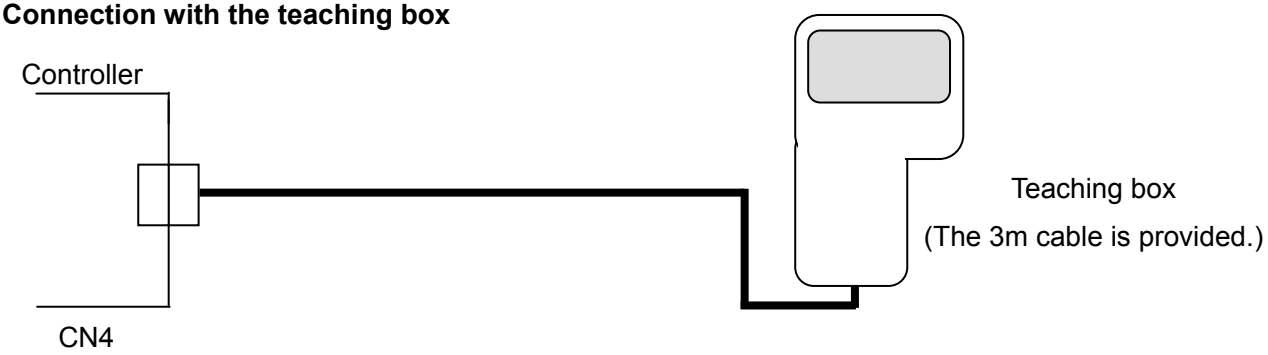
4.2 CN2: Motor power connector and CN3: Encoder connector

Connect the controller and the actuator with the actuator cable (LE-CP-*-*).

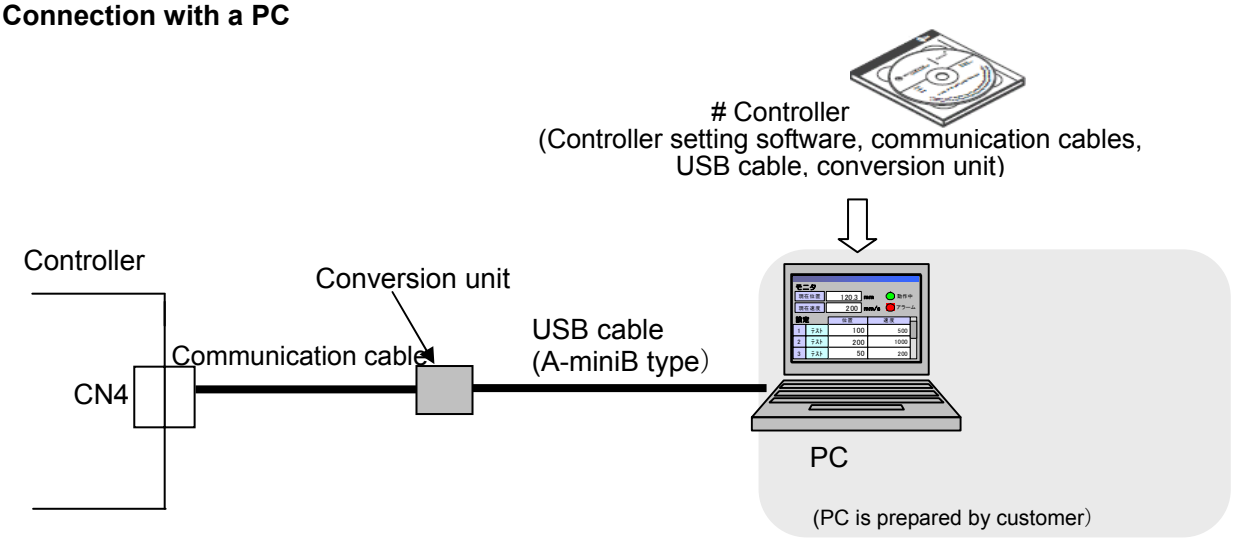


4.3 CN4: Serial I/O connector

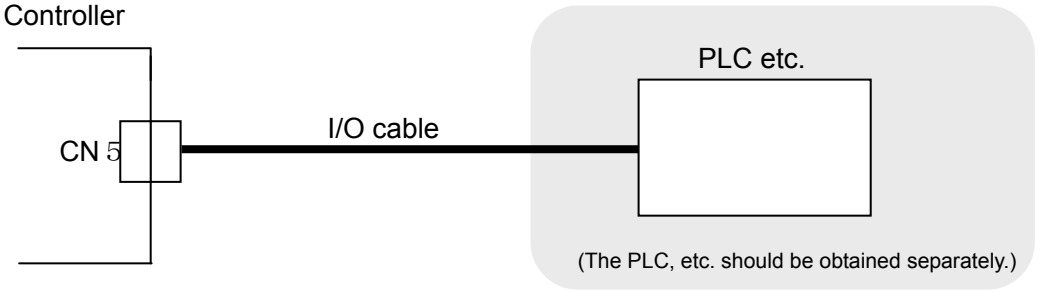
(1) Connection with the teaching box



(2) Connection with a PC



4.4 CN5: Parallel I/O connector



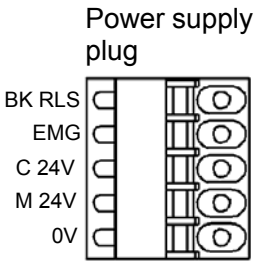
* Please refer to **“6.4 Parallel I/O Wiring Example”** for how to wire the CN5 connector.
* Please refer to **"6.3 Parallel I/O cable wiring details for controller CN5 connector to PLC"** for details of each signal of parallel I/O.

5. CN1: Power supply plug

5.1 Power supply plug specifications

The specifications of the provided power supply plug are as follows.

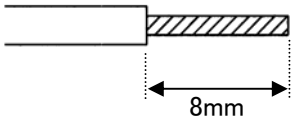
Power supply plug



Terminal	Function	Description
BK RLS	Lock release (+)	The positive power for lock release.
EMG	Stop signal (+)	The positive power for Stop signal.
C24V	Control power (+)	The positive control power.
M24V	Motor power (+)	The positive power for the actuator motor to be supplied via the controller.
0V	Common power (-)	The negative common power for M24V, C24V, EMG and BK RLS.

5.2 Electric wire specifications

Prepare electric wire according to the following specification:

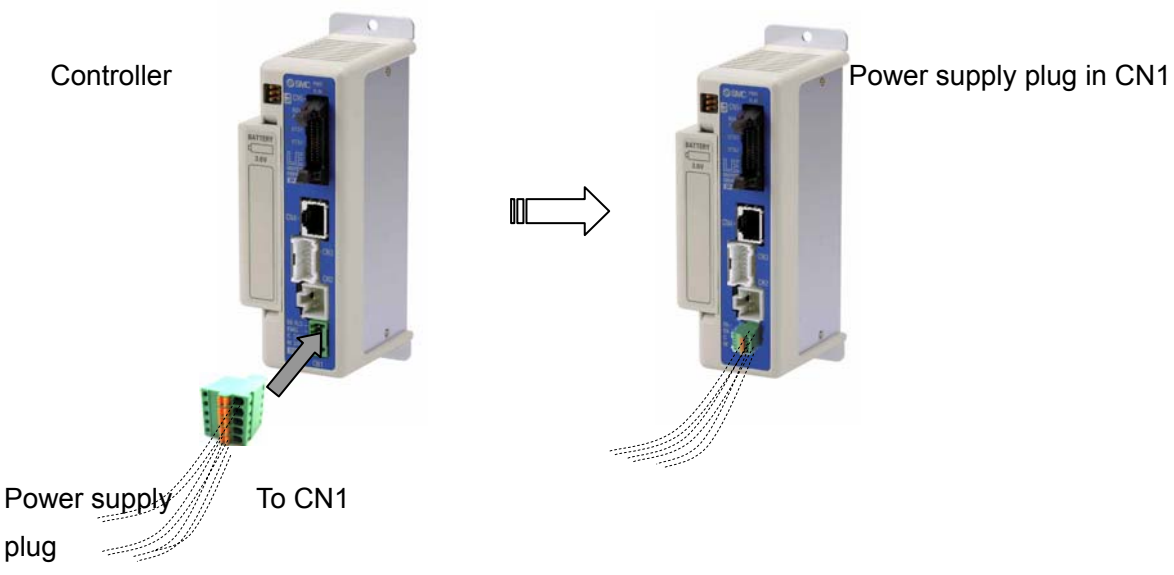
Item	Specifications
Applicable wire size	AWG20 (0.5mm^2): Single line, No insulation sleeve, Twisted wire with bar terminal * The rated temperature for the insulation coating: 60^{o}C or more.
Stripped section length	

⚠Caution

Multiple electric wires should not be connected to one terminal.

After the wiring of the power supply plug is completed, connect it to the CN1 connector of the controller.

Please refer to **"5.3 Wiring of power supply plug"** for how to wire the power supply plug.

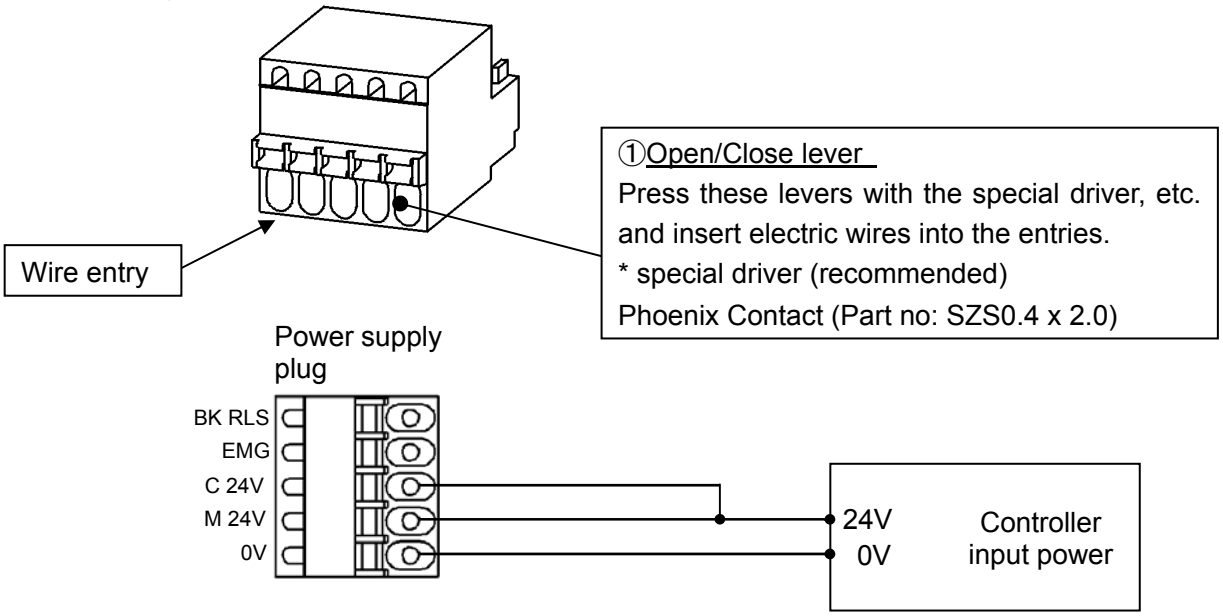


5.3 Wiring of power supply plug

Connect the power supply plug to the 24VDC controller power supply according to instructions (1) (2) and (3) and then insert it into the CN1 connector of the controller.

(1) Wiring of the power supply plug

Connect the positive of the 24VDC controller power supply to the C24V and M24V and connect the negative of that power supply to the 0V terminal.



⚠Caution

Do not use a power supply with “inrush-current control” for the controller power supply.

(2) Wiring of the stop switch

Stop switch must be installed by the user to stop the actuator in abnormal situations.

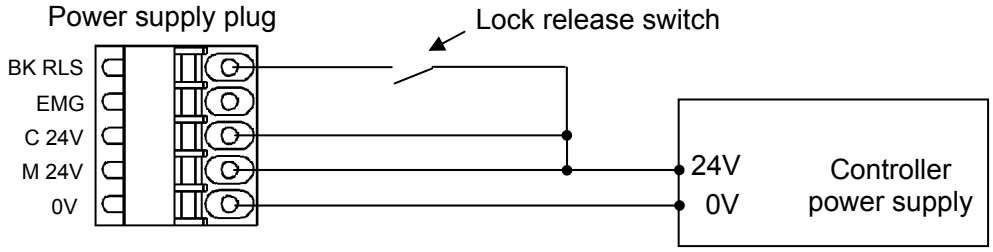
Please refer to **“5.4 Stop circuits”** for examples of how to wire stop switches.

(3) Wiring of the lock release

Actuators with lock will need a lock release switch fitted.

* The switch (24VDC, Contact capacity: 0.5A or more) should be obtained separately.

One terminal of the lock release switch should be connected to the 24VDC power supply and the other should be connected to the BK RLS terminal. When this is switched on, the lock will be released forcibly.



⚠Caution

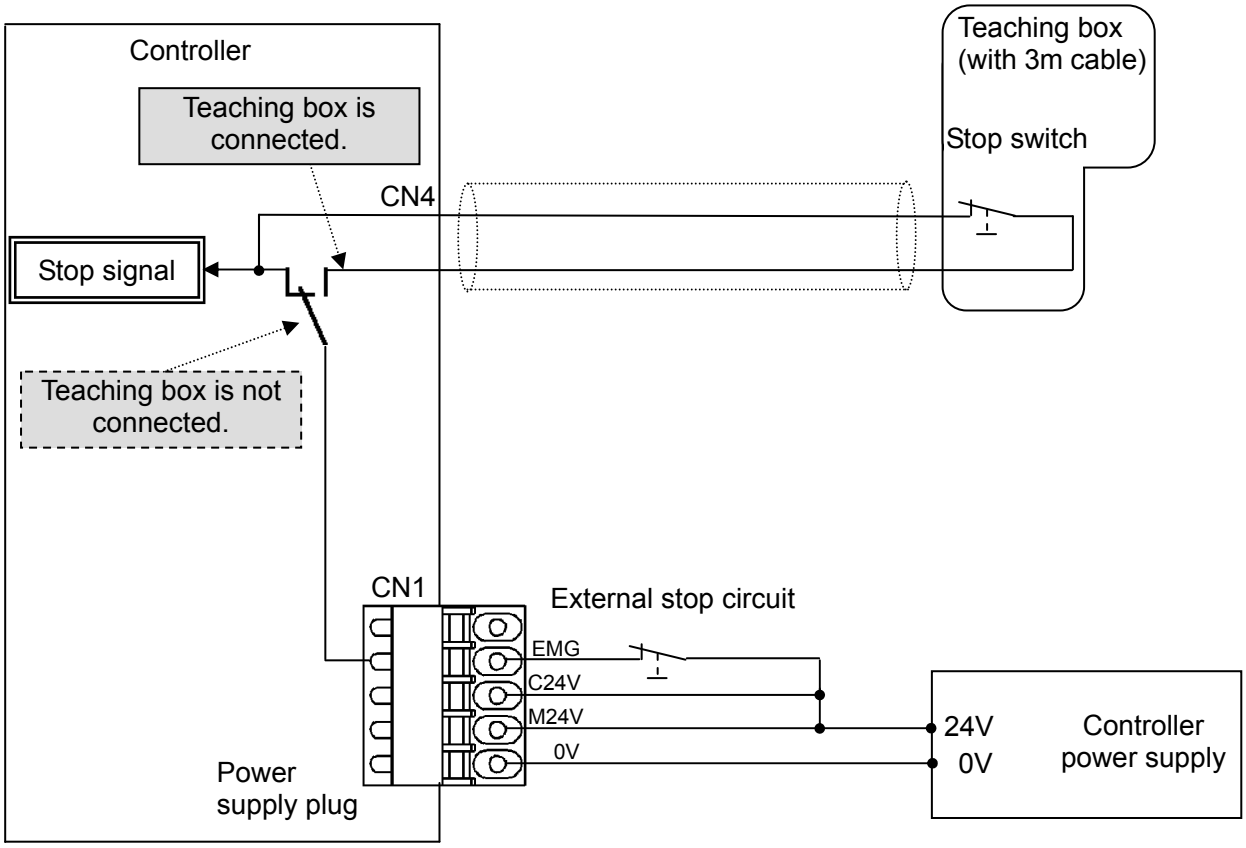
1. If the actuator is a non lock type, it is not necessary to wire the BK RLS terminal.
2. The BK RLS terminal is only used for adjustment and emergency return. It must not be energized during normal operation.

5.4 Stop circuits

- The controller can provide a 'controlled stop' when the +24 VDC is removed from the 'EMG' pin. In a controlled stop condition the controller decelerates the actuator with maximum deceleration value for the actuator
- The stop switch on the teaching box causes a controlled stop if activated.
- For an Emergency stop the 24 VDC power supply should be disconnected from the motor (M24V).

(1) Example circuit 1- Single controller with teaching box

When the teaching box is connected to the controller, the teaching box's stop switch will become effective.



⚠Warning

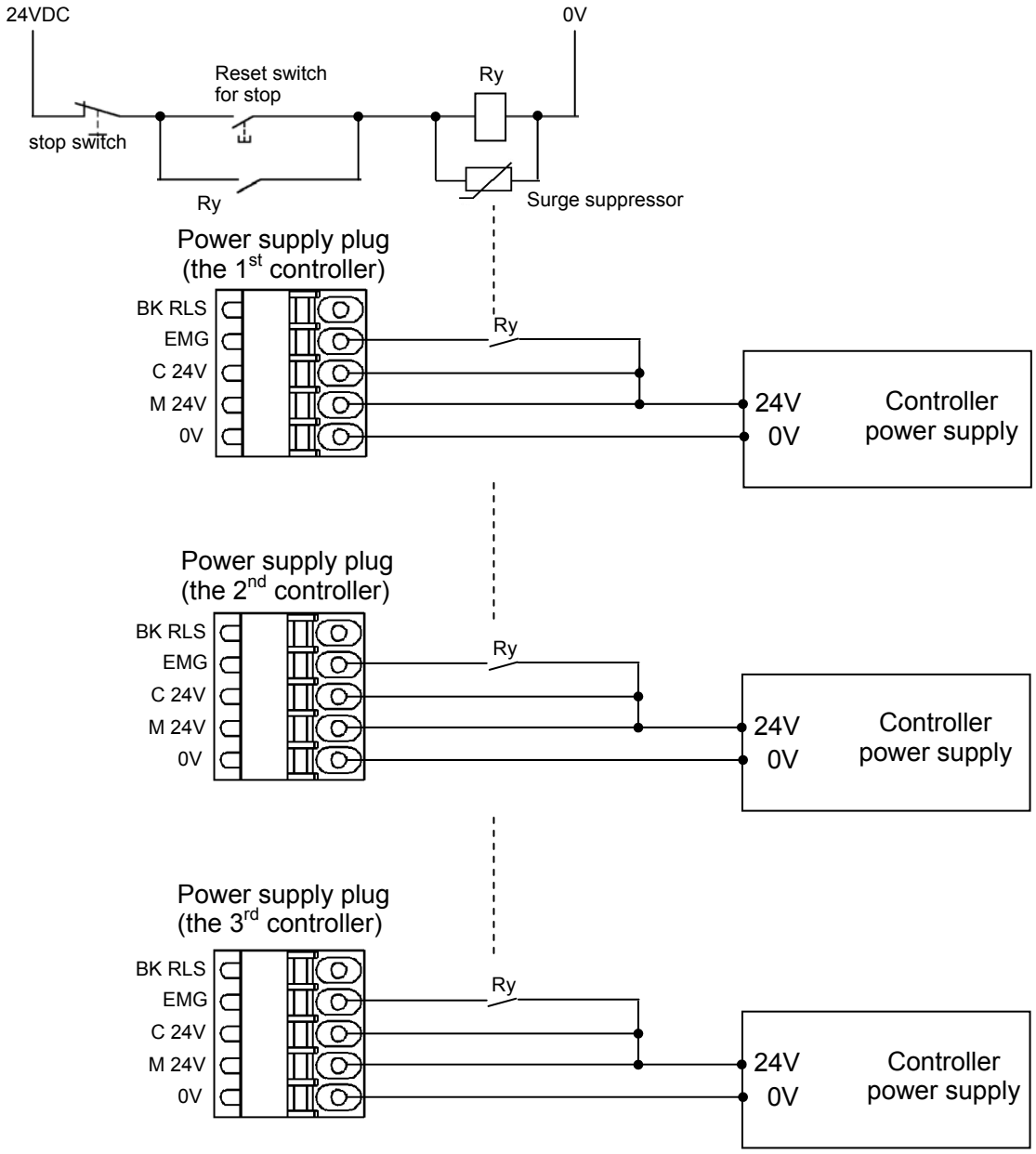
The teaching box's stop switch is effective only for the controller that is connected with it.

When shutdown is input, the controller stops with maximum deceleration speed, then the motor is turned off.

(2) Example circuit 2 - multiple controllers (Stop relay contact (1))

If the system where this controller is installed has a stop circuit for the whole system, or if the system has multiple controllers with individual power supply, relay contacts should be made between the 24VDC controller power supply and the EMG terminal of the power supply plug.

(Circuit example)



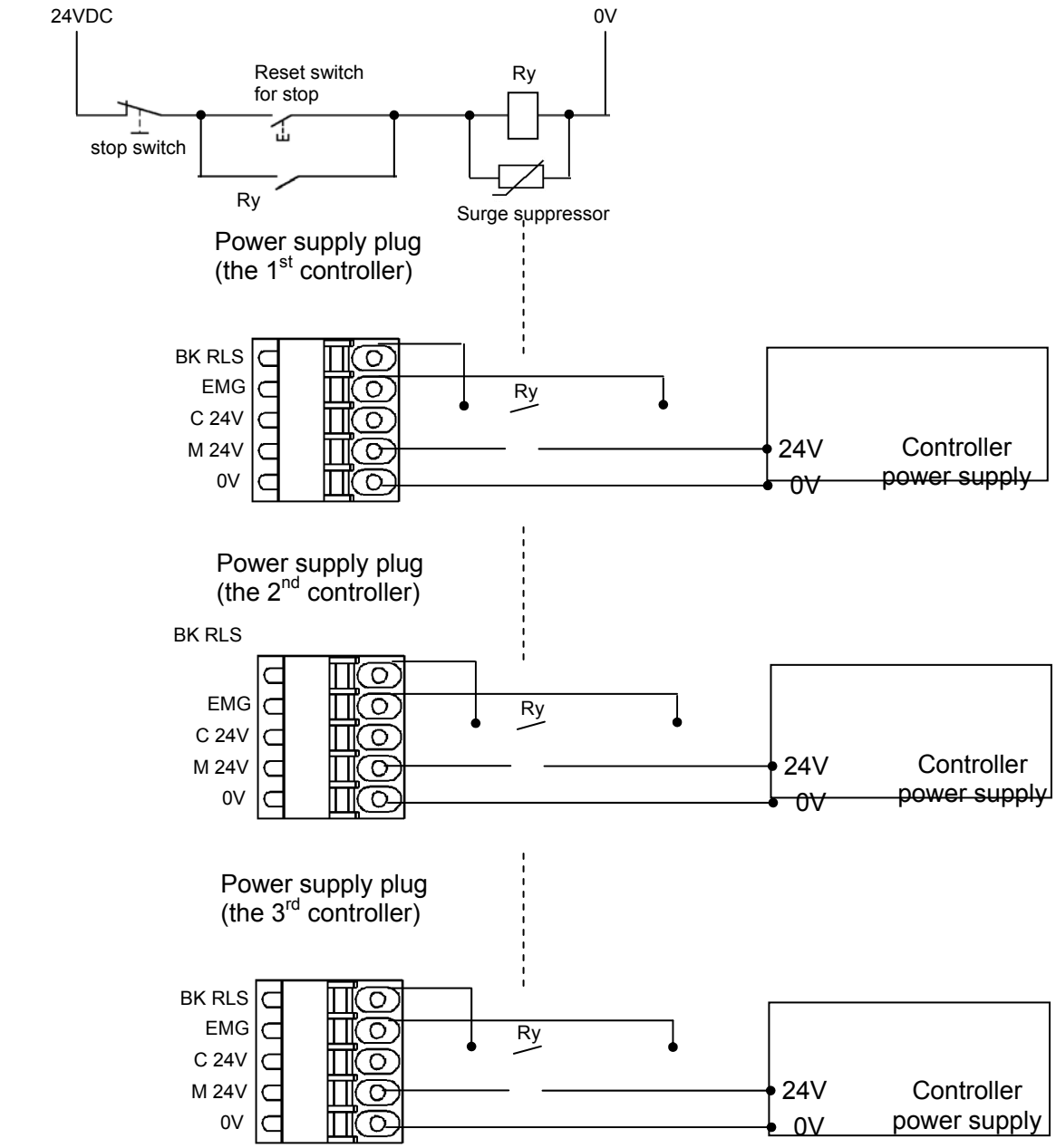
The relay must be a safety relay or monitored by a safety relay.

⚠Caution
When shutdown is input, the controller stops with maximum deceleration speed, then the motor is turned off.

(3) Example circuit 3 - Motor power shutdown (relay contact (2))

If it is necessary to have a circuit to shutdown the motor power externally, relay contacts should be made between the 24VDC controller power supply and the M24V and EMG terminal of the power supply plug.

Circuit example



The relay must be a safety relay or monitored by a safety relay.

⚠Warning

1. Relay contacts should be made between the 24VDC controller power supply and the M24V and EMG terminal of the power supply plug. The actuator may make unexpected movement.
2. Do not perform return to origin (SETUP input ON) when motor drive power (M24V) is disconnected. The controller cannot recognize the correct origin point if a return to origin instruction is made with the motor drive power (M24V) disconnected.
3. Do not energize the BK RLS terminal while the motor drive power (M24V) is disconnected.

6. CN5: Parallel I/O Connector

6.1 Parallel I/O specifications

*** Input specifications**

No.	Item	Specification
1	Input circuit	Internal circuit and photo coupler isolation
2	Number of inputs	11 inputs
3	Voltage	24VDC +/- 10%
4	Input current when ON	3.5mA±20% (at 24VDC)
5	Input Low Voltage Threshold	11V @ 1.5 mA

*** Output specifications**

No.	Item	Specification
1	Output circuit	Internal circuit and photo coupler Isolation
2	Number of outputs	13 outputs
3	Max. voltage between terminals	30VDC
4	Max. output current	10mA supply/sink
5	Saturation voltage	2.0V (Max.)

6.2 Parallel I/O type (NPN/PNP type)

There are two types of parallel I/O for this controller: NPN type (LECP7N**-*) and PNP type (LECP7P**-*).

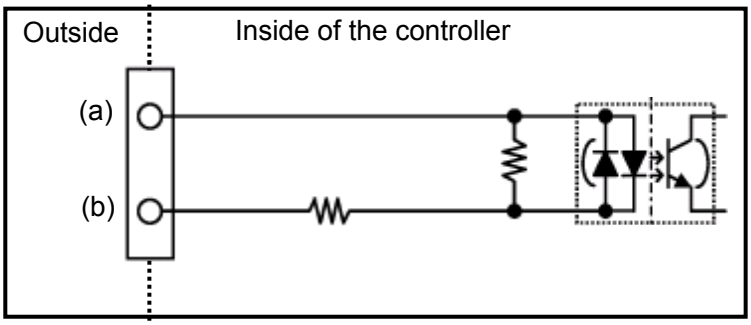
(1) Parallel I/O input circuit (same for both NPN and PNP type)

NPN type

(a)	「COM+」〈A1〉
(b)	IN0〈A3〉-SVON〈A13〉

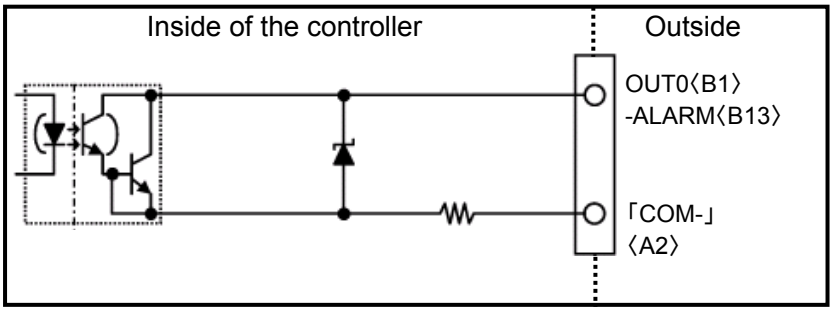
PNP type

(a)	「COM-」〈A2〉
(b)	IN0〈A3〉-SVON〈A13〉

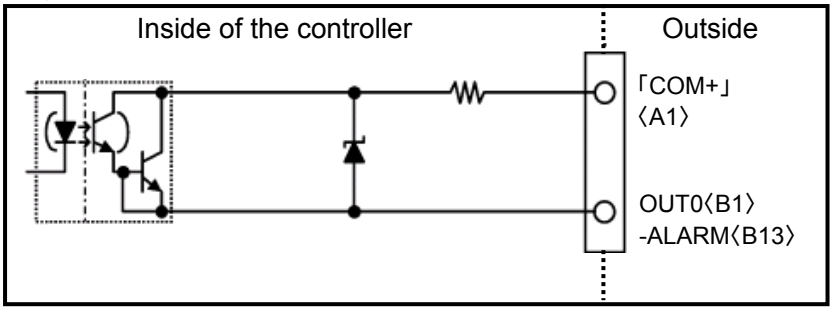


(2) Parallel I/O output circuit

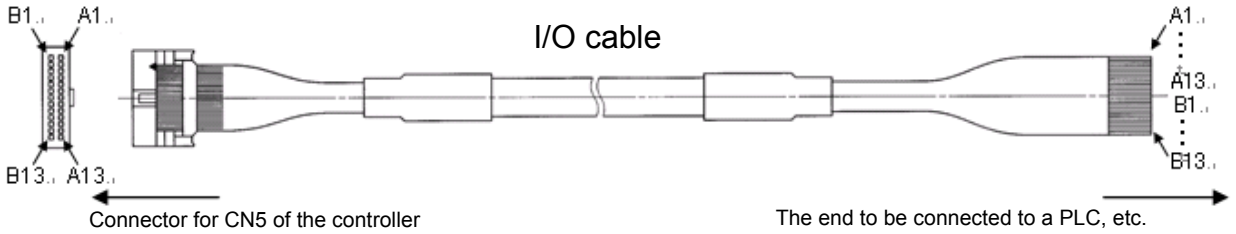
NPN type



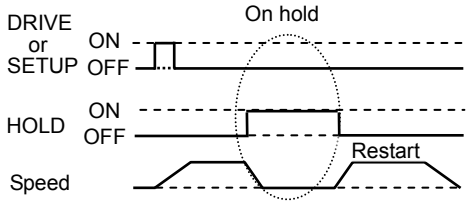
PNP type



6.3 Parallel I/O cable wiring details for controller CN5 connector to PLC



- Input terminal-

No.	Function	Description
A1	COM+	The terminal for the 24V of the 24VDC I/O signal power.
A2	COM-	The terminal for the 0V of the 24VDC I/O signal power.
A3 A4 A5 A6 A7 A8	IN0 IN1 IN2 IN3 IN4 IN5	Bit no. to specify the step data (Specify the number by combining On/Off of the terminals.) Example: (Bit no. to specify the step data no.3.) IN5 | IN4 | IN3 | IN2 | IN1 | IN0 OFF | OFF | OFF | OFF | ON | ON 0 | 0 | 0 | 0 | 1 | 1 ← Binary code
A9	SETUP	When SVRE (B11) is ON, the SETUP operation (return to origin operation) will be performed. During the SETUP operation, BUSY (B7) will be turned ON and after completion of the SETUP operation, SETON (B9) and INP (B10) will be turned ON.
A10	HOLD	If HOLD input is ON during operation, the speed decreases at maximum deceleration speed of the basic parameter until the actuator stops. The remaining stroke will be on hold as long as HOLD is ON and when HOLD is turned OFF, the actuator restarts to travel the remaining stroke. * When DRIVE or SETUP is ON:  **Caution** 1. As long as HOLD is ON, the DRIVE input will be disabled. 2. The output signals are rendered invalid whilst hold is in operation.
A11	DRIVE	When DRIVE is turned ON, the system scans the input IN0 to IN5 and starts the operation of the actuator. Then, when this terminal is turned OFF, the number of the active step data will be output via the terminals OUT0 to OUT5.
A12	RESET	The terminal to reset the alarm and the operation. After RESET, the speed decreases at maximum deceleration speed of the basic parameter until the actuator stops. INP and OUT0 to OUT5 will be turned OFF (however, if the actuator is stopped within the in-position range, the INP will be turned ON).
A13	SVON	When SVON is ON, the servo motor will be turned ON. When this is OFF, the servo motor will be turned OFF.

Effective condition of the Parallel I/O signal

Signal name \ Condition	SETON	SVRE	BUSY
SETUP (Return to origin)	-	ON	OFF (*1)
DRIVE (Operation start instruction)	ON	ON	-

("-" = Does not depend on the ON/OFF state of the each output signal)

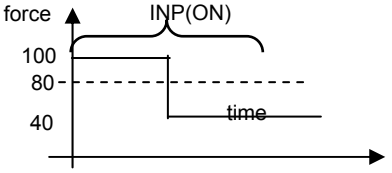
*1 During the positioning operation the SETUP input will be disabled whilst hold is in operation.

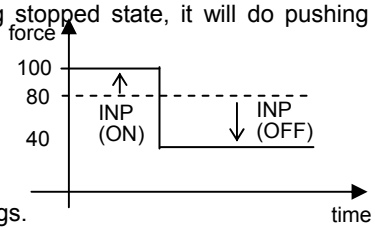
⚠Caution

SETUP and DRIVE can only be accepted during the above conditions. An Alarm condition will be generated at other times. Keep the input signal combination for 15 ms (30 ms if possible) or longer.

-Output terminal-

No.	Function	Description
B1	OUT0	When the operation is started and DRIVE is turned OFF, a Bit no. corresponding to the number of the active step data will be output from these terminals. This output signal will be updated when DRIVE (A11) terminal is turned ON. **⚠ Caution** 1 When RESET is turned ON, these terminals are turned OFF. 2 During the alarm, these terminals output the alarm group. 3 During the pushing operation, if the actuator runs over the defined pushing width, these terminals will be turned OFF.
B2	OUT1	
B3	OUT2	
B4	OUT3	
B5	OUT4	
B6	OUT5	
B7	BUSY	This terminal is ON during the movement of the actuator (during the positioning operation, etc.). **⚠ Caution** During the pushing operation without movement (no movement but the actuator generating the pushing force), BUSY is OFF. BUSY signal stays on for 50ms or longer after operation starts.
B8	AREA	When the actuator is within the range between Area 2 and Area1 in the step data, this terminal will be turned ON. The range changes depending on the active step data.
B9	SETON	When the actuator is in the SETON status (the position information is established), this terminal is turned ON. When the position status is not established, this terminal is OFF.
B10	INP	The condition when the INP output is ON depends on the actuator action. • Return to origin Turns ON at the origin when within the ±"default Inposition" in the Basic parameter. • During positioning operation Turns ON when the current position is within "Step data position +/- positioning range". • During pushing operation Turns ON when the pushing force exceeds the value set in the step data "Trigger LV".

<table>
<tr><td>B10</td><td>INP
continued</td><td>
⚠Caution
(1) After the pushing operation is completed, even if it switches automatically to energy saving mode, the INP output signal stays ON.
When movement starts again from the pushing stopped state, pushing operation is repeated with the normal pushing force.
(Example) Step data “force” is 100%
Step data “Trigger LV” is 80%,
The energy saving setting of the actuator is 40%(*1)


(2) If controller version is below SV1.00 .
During pushing operation in energy saving mode, if the energy saving setting is less than the Trigger LV value, the INP output signal will turn OFF.
When movement starts again from the pushing stopped state, it will do pushing operation with energy saving pushing force.
(Example) Step data “force” is 100%
Step data “Trigger LV” is 80%
The energy saving setting of the actuator is 40%.(* 1)


(*1)The actuator model determines the energy settings.
Please refer to the specifications of actuator for more details.
If the stop is input from the EMG or RESET terminal or the stop-switch on the connected Teaching Box during pushing operation, the actuator stops.
(“Busy” signal turns OFF) If the actuator stops within the range of ”Position”± ”In pos” defined in step data, output signal “INP” turns ON.
</td></tr>
<tr><td>B11</td><td>SVRE</td><td>When the servo motor is OFF, SVRE is OFF. When the servo motor is ON, SVRE is ON.</td></tr>
<tr><td>B12</td><td>*ESTOP</td><td>During activation of Teaching Box stop switch, this terminal is OFF. During the normal operation, this is ON. This is synchronized to the input terminal for the EMG signal on the controller connector CN1.</td></tr>
<tr><td>B13</td><td>*ALARM</td><td>When there are no alarms, this terminal is ON.
When there are alarms, this is OFF.</td></tr>
</table>

The table below shows the changes in the output signal with respect to the state of the controller.

State \ Output signal	BUSY	INP	SVRE	Lock	SETON	OUT0-5
Controller powered down [SVOFF] with no motion	OFF	OFF	OFF	Lock	OFF	OFF
Controller powered down [SVON] with no motion	OFF	OFF	ON	Release	OFF	OFF
During returning to origin, [SETUP].	ON	OFF	ON	Release	OFF	OFF
The actuator is at the origin. On completion of [SETUP]	OFF	ON (* 1)	ON	Release	ON	OFF
During movement by positioning/pushing operation.	ON	OFF	ON	Release	ON	ON (* 2)
The actuator is paused by [HOLD]	OFF	OFF	ON	Release	ON	ON (* 2)
On completion of the positioning operation.	OFF	ON (* 4)	ON	Release	ON	ON (* 2)
Stopped due to pushing a workload in pushing operation.	OFF	ON	ON	Release	ON	ON (* 2)
Stopped due to no detection of workload during a pushing operation.	OFF	OFF	ON	Release	ON	OFF
On completion of return to origin and then with [SVON] turned off.	OFF	OFF (* 4)	OFF	Lock	ON	ON (* 3)
EMG signal stop from the CN1 connector after the actuator is at the origin.	OFF	OFF (* 4)	OFF	Lock	ON	OFF

* 1: The output turns on when the actuator is within the range defined in the basic parameter setup.

* 2: The output is updated on the transition from (ON→OFF) of the DRIVE input signal.

* 3: Retains the previous state.

* 4: The output turns on when the actuator is "In position" of the step data.

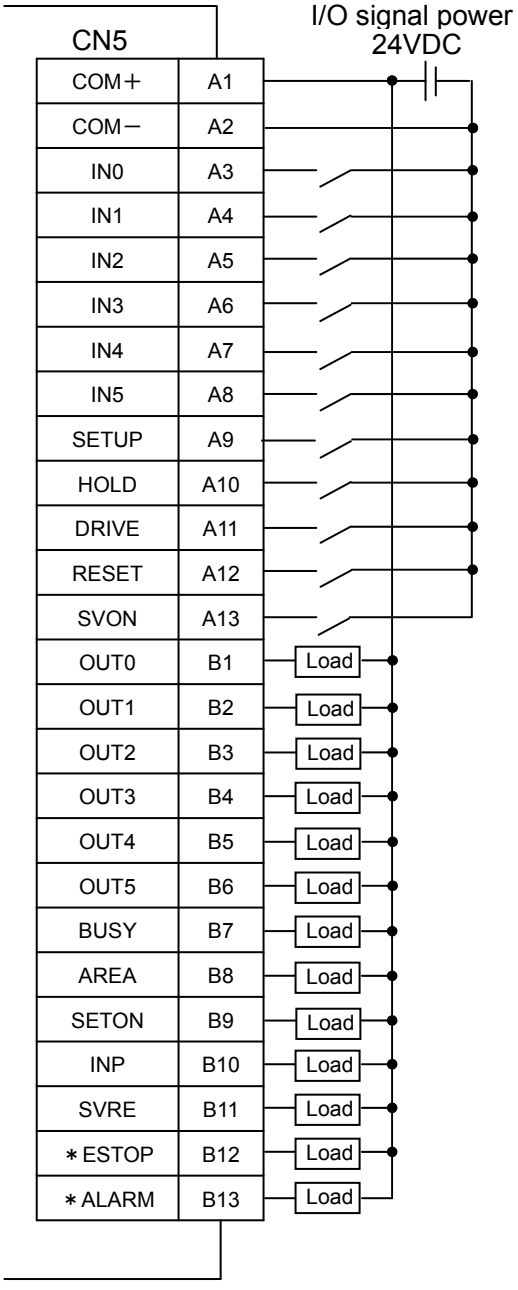
6.4 Parallel I/O Wiring Example

When you connect a PLC, etc. to the CN5 parallel I/O connector, please use the I/O cable (LEC-CN5-*).

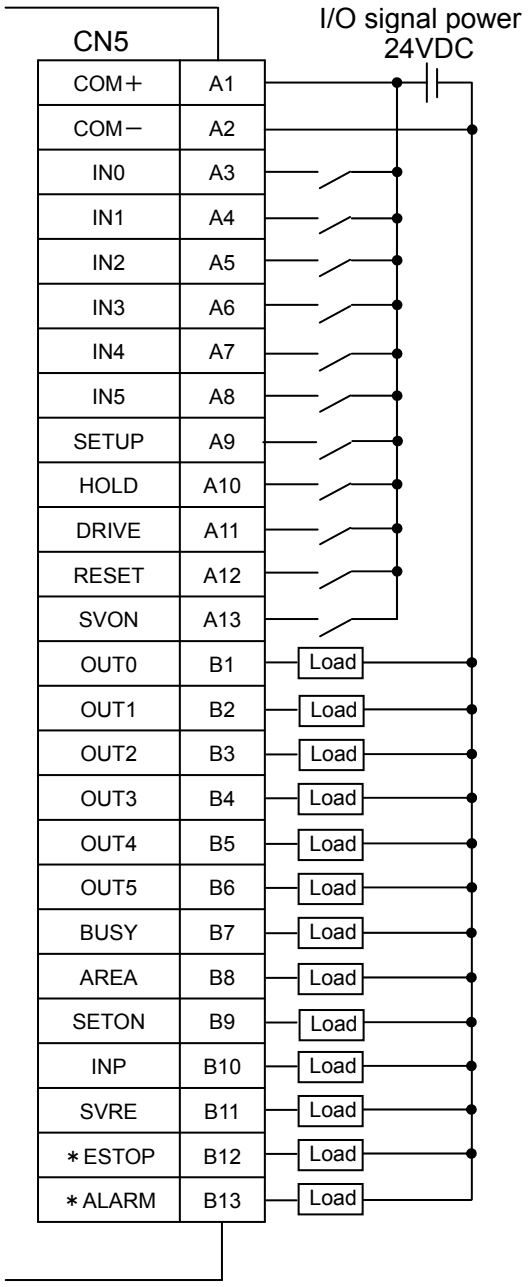
The wiring depends on the type of the parallel I/O (NPN or PNP).

Please wire referring to the following diagram

*** NPN type**



*** PNP type**



⚠ Caution

The 24VDC controller power supply for CN1 and the 24VDC I/O power supply for CN5 should be separated.

7. Setting Data Entry

In order to move the actuator to a specific position, it is necessary to setup the patterns of operations with a PC (with the controller setting software) or the teaching box. This setup data input by the software or teaching box will be recorded in the memory of the controller.

For the controller setting software and the teaching box, there are two available modes (Easy mode and Normal mode). You can select the appropriate one depending on the operation.

* Easy mode

  In Easy mode, you can start up the actuator by entering only a limited number of settings with the controller setting software and the teaching box.

  * The combination of settings you need to set up will change depending on the type of actuator (combination of data can be selected).

* Normal mode

  In Normal mode, you can make a further detailed setup (conditions for actuator and controller, etc.) in addition to the Easy mode.

  You can change three kinds of setting data, “Step data,” “Basic parameter” and “Return to origin parameter” in this mode.

7.1 Step data

A “step data” is the setting data mainly describing the movement of the actuator. Total 64 step data (12 types) can be handled with this controller. Each step data will become effective as soon as it is recorded into the controller.

(Example) Step data on the PC (controller setting software) screen [Normal mode]

No.	Move	Speed mm/s	Position mm	Accel mm/s^2	Decel mm/s^2	PushingF %	TriggerLV %	PushingSp mm/s	Moving F %	Area1 mm	Area2 mm	In pos mm
0	Absolute	100	20.00	1000	1000	0	0	0	100	18.00	22.50	0.5
1	Absolute	50	10.00	1000	1000	70	60	5	100	6.0	12.0	1.5
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
63	Absolute	20	5.00	500	500	0	0	0	100	3.0	8.0	1.2

Details of step data

<table>
<tr><th>Setting name</th><th>Range</th><th>Description</th></tr>
<tr><td>No.</td><td>0 to 63</td><td>Number of the step data.</td></tr>
<tr><td>MovementMOD</td><td>3 options
(Refer to the table on the right.)</td><td>The setting to specify the coordinate system for the target position.
<table>
<tr><th>Software</th><th>TB</th><th>Description</th></tr>
<tr><td>Blank</td><td>Disable</td><td>The step data is ineffective.</td></tr>
<tr><td>Absolute</td><td>Absolute</td><td>The target position will be defined by the absolute coordination based on the zero point.</td></tr>
<tr><td>Relative</td><td>Relative</td><td>The target position will be defined by the relative coordination based on the current position.</td></tr>
</table></td></tr>
<tr><td>Speed</td><td>1 to “Max speed” of the basic parameter</td><td>The speed to move to the target position (Unit: mm/s)</td></tr>
<tr><td>Position</td><td>“Stroke (-)” to “Stroke (+)” of the basic parameter</td><td>The target position (Unit: mm)</td></tr>
<tr><td>Acceleration</td><td>1 to “Max ACC/DEC” of the basic parameter</td><td>The acceralation to reach the Speed (Unit: mm/s^2)</td></tr>
<tr><td>Deceleration</td><td>1 to “Max ACC/DEC” of the basic parameter</td><td>The deceleration to reach the Speed (Unit: mm/s^2)</td></tr>
<tr><td>Pushing force</td><td>1 to “Max force” of the basic parameter</td><td>The setting to define the pushing operation or the positioning operation.
For the positioning operation, the value specifies the force as a percentage of the maximum force (Unit: %).
* The maximum force depends on the actuator. Please refer to the manual and the rated force of the actuator.
<table>
<tr><th>Value</th><th>Operation</th><th>Description</th></tr>
<tr><td>0</td><td>Positioning operation</td><td>The actuator moves to the position specified in the “Position”.</td></tr>
<tr><td>1-100</td><td>Pushing operation</td><td>The actuator moves to the position specified in the “Position” and then, performs a pushing action with a force not more than the set force.</td></tr>
</table></td></tr>
<tr><td>Trigger LV</td><td>1 to “Max force” of the basic parameter”</td><td>* Effective only for the pushing operation (when the value for the “Pushing force” is from 1 to 100).
This is the setting to define the conditions where the INP will be turned ON. When the actuator generates a force over this value, INP will be turned ON. (Unit: %)
For the positioning operation, this value is ignored.</td></tr>
</table>

<table>
<tr><td>Pushing speed</td><td>1 to “Max force” of the basic parameter</td><td>* Effective only for the pushing operation (when the value for the “Pushing force” is from 1to 100).
This defines the movement speed during the pushing operation. If this Speed is too high, it may cause damage to the actuator or work piece due to impacts. Therefore, enter a value within the range appropriate for the actuator. (Unit: mm/s)
* Please refer to the actuator manual for the appropriate range of the speed.
* For the positioning operation, this value is ignored.</td></tr>
<tr><td>Moving force</td><td>* 1</td><td>The setting to define the maximum torque during the positioning operation. (Unit: %)
Enter a value within the range appropriate for the actuator. (Unit: mm/s).
* Please refer to the actuator manual for the appropriate range of the speed.</td></tr>
<tr><td>Area1</td><td>“Stroke (-)” to “Stroke (+)” of the basic parameter</td><td rowspan="2">The setting to define the conditions where the AREA output will be turned ON (Unit: mm).
If the current position is within the range between the Area1 and Area2, the AREA output will be turned ON.
* If Area1 >Area2, the alarm “Step Data ALM1” will be activated.
(However, no alarm is generated if “Area1”= “Area2”= 0, the AREA output will be turned OFF)</td></tr>
<tr><td>Area2</td><td>“Stroke (-)” to “Stroke (+)” of the basic parameter</td></tr>
<tr><td>In position</td><td>* 1</td><td>The functions of this will be different between the pushing operation and the positioning operation.
* Positioning operation: Positioning range (Unit: mm)
* Pushing operation: Pushing distance (Unit: mm)
<table>
<tr><th>Operation</th><th>Description</th></tr>
<tr><td>Positioning operation</td><td>This is the setting to define the conditions where the INP output will be turned ON.
When the actuator enters within this range from the target position, the INP will be turned ON.
(It is unnecessary to change this from the initial value.)
If it is required to get a signal before the actuator completes the positioning operation, this value should be larger.
* The INP output will be turned on. Target position - in position ≦ actuator position ≦ target position + in position</td></tr>
<tr><td>Pushing operation</td><td>This is the setting to define the distance pushed by the actuator during the pushing operation.
When the actuator pushed exceeding this distance, the pushing operation will end.
In case of such stop exceeding the pushing distance, the INP will not be turned ON.</td></tr>
</table></td></tr>
</table>

* 1: The range varies depending on the actuator. Please refer to the manual of the actuator for more details.

7.2 Basic parameters

The “Basic parameter” is the data to define the operating conditions of the controller, conditions of the actuator, etc.

Details of basic parameters

Activation: “XX” = Effective as soon as it is recorded into the controller

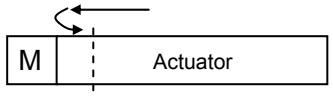
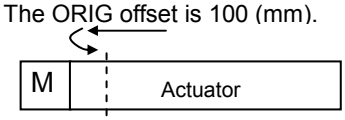
“X” = Become effective after restarting the controller

“-“ = The parameter cannot be changed (fixed value)

Parameter name	Range	Description	Acti-vation
Controller ID	1 to 32	Identification number (axis) parameters of serial communications are set.	X
IO pattern	Fixed value	This is the fixed value for this controller (* It should not be changed). The value for this should be 64 (Standard).	-
ACC/DEC pattern	Fixed value	This is the fixed value for this controller (* It should not be changed). This defines the trapezoidal acceleration/deceleration parameter.	-
S-motion rate	Fixed value	This is the fixed value for this controller (* It should not be changed).	-
Stroke (+)	* 1	This defines the positive (+) side limit of the position. (Unit: mm) Any value greater than the [stroke(+)] value cannot be entered in the “Position” field data of step parameter setup.	XX
Stroke (-)	* 1	This defines the negative (-) side limit of the position. (Unit: mm) Any value less than the [stroke(-)] value cannot be entered in the “Position” field data of step parameter setup.	XX
Max speed	* 1	This defines the maximum limit of the speed (Unit: mm/s). Any value greater than the [Max speed] value cannot be entered in the “Speed” field data of step parameter setup.	XX
Max ACC/DEC	* 1	This defines the maximum limit of the ACC/DEC (Unit: mm/s^2). Any value greater than the [Max ACC/DEC] value cannot be entered in the “Accel” field data of step parameter setup.	XX
Def In position	* 1	This defines the range to activate the INP output when the actuator is within it after the return to origin operation. (Unit: mm)	XX

* 1: The range varies depending on the actuator. Please refer to the manual of the actuator for more details.

<table>
<tr><td>ORIG offset</td><td>* 1</td><td>This defines the position of the actuator after the return to origin operation. (Unit: mm)

* The ORIG offset is 0 (mm).
 
The position recognized by the controller after the return to the origin operation (0mm).
* The ORIG offset is 100 (mm).
 
The position is identified by the controller after the return to the origin operation (100mm).

In the examples on the left, the actuator positions are not different but the reference point that the controller recognizes will be changed after the return to origin operation.

⚠ Caution
If the value for the “ORIG offset” is changed, the “Stroke (+)” and “Stroke (-)” of the basic parameter should be checked.</td><td>XX</td></tr>
<tr><td>Max force</td><td>* 1</td><td>The maximum force for the pushing operation (Unit: %).</td><td>XX</td></tr>
<tr><td>Para protect</td><td>1 to 2</td><td>Sets the range in which parameter and step data can be changed.
1. Basic parameter + Step data（Basic parameter + Return to origin parameter + Step data）
2. Basic parameter（Basic parameter + Return to origin parameter）</td><td>XX</td></tr>
<tr><td>Enable SW</td><td>1 to 2</td><td>This defines the status of the Enable switch of the teaching box.
1. Enable
2. Disable</td><td>XX</td></tr>
<tr><td>Unit name</td><td>Fixed value</td><td>Indication of actuator type compatible with the controller.
(* It should not be changed).</td><td>-</td></tr>
<tr><td>W-AREA1</td><td>Fixed value</td><td>This is the fixed value for this controller (* It should not be changed).</td><td>-</td></tr>
<tr><td>W-AREA2</td><td>Fixed value</td><td>This is the fixed value for this controller (* It should not be changed).</td><td>-</td></tr>
<tr><td>ORG Correct [Link Offset]</td><td>Fixed value</td><td>This is the fixed value for this controller (* It should not be changed).</td><td>-</td></tr>
<tr><td>Sensor type</td><td>Fixed value</td><td>This is the fixed value for this controller (* it should not be changed)</td><td>-</td></tr>
<tr><td>Option 1</td><td>Fixed value</td><td>This is the fixed value for this controller (* it should not be changed)</td><td>-</td></tr>
<tr><td>Undefine No.11</td><td>Fixed value</td><td>This is the fixed value for this controller (* it should not be changed)</td><td>-</td></tr>
<tr><td>Undefine No.12</td><td>Fixed value</td><td>This is the fixed value for this controller (* it should not be changed)</td><td>-</td></tr>
</table>

* 1: The range varies depending on the actuator. Please refer to the manual of the actuator for more details.

Basic parameter (Items exclusive to absolute controller)

Description		Input Scope	Content
Controller Software	Teaching box		
Setting not available	Sensor type	1, 2 *2	1: Incremental (Encoder signal is not backed up when the power supply is interrupted) 2: Absolute (Encoder signal is backed up when the power supply is interrupted)

*2: Parameter setting to enable the absolute function of the controller.

Confirm if "2: Absolute" is selected for the setting of "Sensor type" in order to enable the controller absolute function. (Default setting is ”2: Absolute”)

When the parameters are changed, they become valid after recycling the power supply.

⚠ Caution

When "1: Incremental" is selected, absolute function becomes invalid.

7.3 Return to origin parameter

The “Return to origin parameter” is the setting data for the return to origin operation.

Details of Return to origin parameter

Activation: “XX” = Becomes effective as soon as it is recorded into the controller,

“X” = Becomes effective after restarting the controller,

“-“ = The parameter cannot be changed (fixed value).

Name	Range	Description	Acti-vation
ORIG direction	1 to 2	Sets the direction of return to origin operation. 1. CW 2. CCW *1	X
ORIG mode	1 to 2	The setting for the return to origin operation 1. pushing origin operation [Stop] 2. limit switch origin [Sensor]	XX
ORIG limit	* 1	A pushing force level at which to set the origin.	XX
ORIG time	Fixed value	This is the fixed value for this controller (* It should not be changed).	-
ORIG speed	* 1	The allowable speed to move to origin.	XX
ORIG ACC/DEC	* 1	The acceleration and deceleration during find origin.	XX
Creep speed	Fixed value	This is the fixed value for this controller (* It should not be changed).	-
ORIG sensor	0 to 2	The setting for ORIG sensor 0. The origin sensor is not effective. [Disable] 1. The origin sensor is N.O type. [N.O]. 2. The origin sensor is N.C type. [N.C.]	XX
ORIG SW DIR	Fixed value	This is the fixed value for this controller (* it should not be changed)	-
Undefine No.21	Fixed value	This is the fixed value for this controller (* it should not be changed)	-

* 1: The range varies depending on the actuator. Please refer to the manual of the actuator for more details.

8. Preparation for Operation

8. 1 Charging of the battery

Battery must be fully charged for 72 continuous hours at initial start-up or any time the battery is replaced.

STS2 LED turns on solid green when charging is complete.

⚠ Caution

It is required to fully charge the battery to satisfy the guideline of the backup period.

When the power supply is interrupted for longer than 1 hour after fully charging the battery, and power is reapplied, STS2 LED lights up orange.

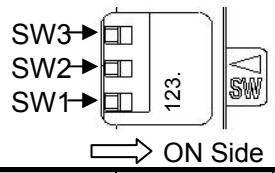
When the battery is fully charged, it is recommended that the surrounding temperature should be 0-30°C.

If the controller is not fully charged and the temperature surrounding the controller exceeds 40°C, the battery life is reduced. At temperatures above 40°C, the battery charge may leak and the performance may deteriorate.

8. 2 Setting the period of power supply (backup) by the switch setting

The power supply (backup) period is set by the combination of SW (switches).

To operate the actuator manually during backup, ensure that the manual rotation of the motor is within the range of the "Maximum manual rotation of the motor after the power supply is cut". If the motor rotation limit is exceeded, or the backup period is exceeded, data providing the encoder position will be lost/corrupted. In this case an alarm is generated.



Backup period guideline	SW1	SW2	SW3	Maximum manual rotation of the motor after the power supply is cut
20 days	OFF	OFF	OFF	100rpm or less
10 days	ON	OFF	OFF	200rpm or less
5 days	OFF	ON	OFF	400rpm or less
2 days	ON	ON	OFF	800rpm or less

* Pushing SW to the side with numbers switches it ON.

* The SW settings come into effect after the power is cut.

⚠ Caution

The guideline for the backup period is based on a fully charged battery (charged for 72 continuous hours) and a surrounding temperature near the controller of20°C.

The replacement time of the battery shortens. Because when the operating temperature rises, the performance of the battery is deteriorated.

"Maximum manual rotation of the motor after the power supply is cut" does not limit the step data speed when the power is supplied.

9. Operations

9.1 Return to origin

After entering the setting data, it is necessary to perform a return to origin operation before starting the positioning or pushing operation. (To ensure the position of origin)

* The return to origin direction is dependent on the actuator.

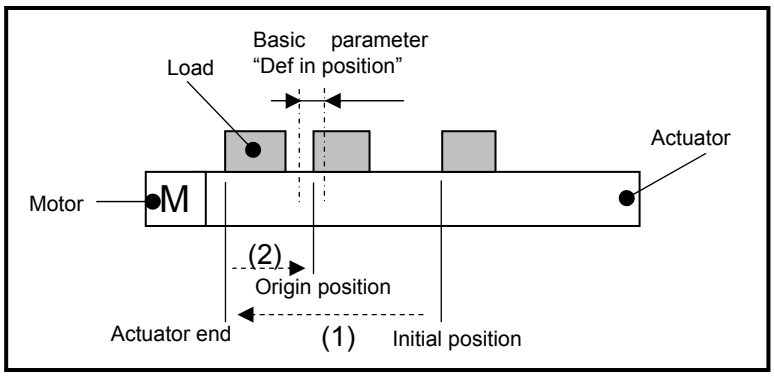
■ Return to origin operation

The actuator moves in the return to origin direction (* this direction is dependent on the actuator) from the initial position at the moment of power-on: See (1) in the diagram below.

When the actuator reaches the end of travel limit it pauses for a short time. The controller recognizes the position as the end of travel limit of the actuator. Then, the actuator moves at a low speed in the direction opposite to the return to origin direction: See (2) in the diagram below.

Return to origin signal → Move in the return to origin direction → Stop the movement → Move in the opposite direction → Origin position

(Example) Return to origin operation



⚠Caution

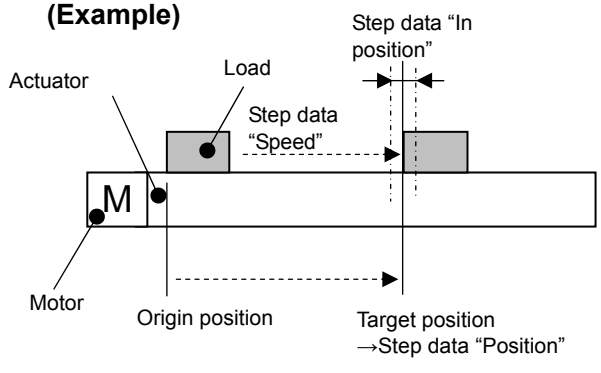
This direction is dependent on the actuator.

9.2 Positioning operation

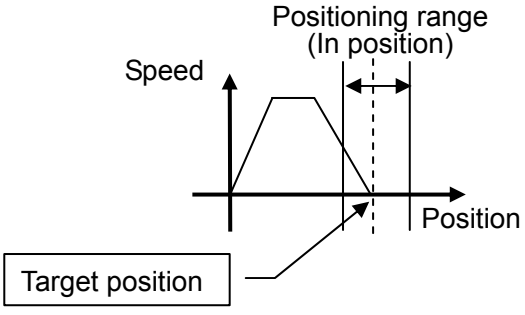
* Step data "Pushing force" is set to 0.

The actuator moves to the target position specified by the step data "Position."

*** Positioning operation (Example)**



*** Positioning operation [Speed/Position] (Example)**



9.3 Pushing operation

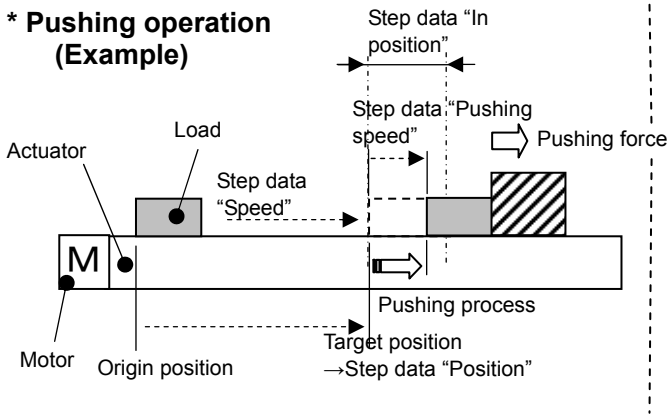
The pushing operation is active when the value of the “Pushing F%” in the Step data is set to “1” or more. Similar to the positioning operation, the actuator moves according to the settings of “Position” and “Speed” in the step data and then, when it reaches the target position, it starts the pushing process.

The actuator pushes the load with a force no more than the maximum force set in the “Pushing force” of the step data.

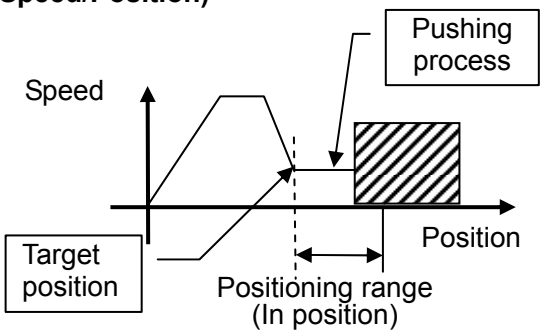
(1) Pushing operation is successfully performed.

During the pushing operation, if the pushing force is kept higher than the value specified by “Trigger LV” of the step data for a certain time, the INP output will be turned ON. Even after the completion of the pushing operation, the actuator keeps generating the force set in the step data.

*** Pushing operation (Example)**

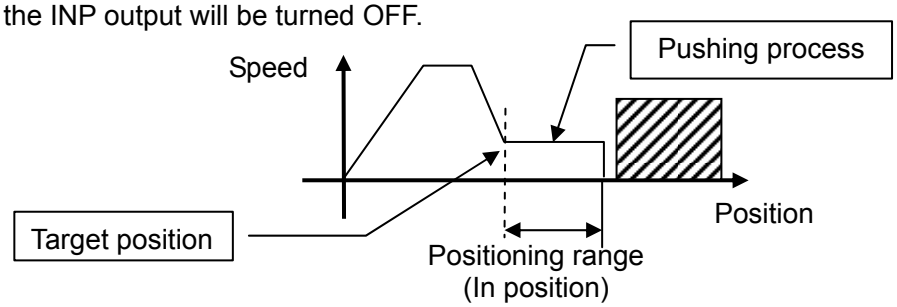


*** Pushing operation (Speed/Position)**



(2) Pushing operation fails (empty pushing).

If the pushing process is not completed even after the actuator runs over the range specified in the step data from the target position (the starting point of the pushing process), the operation will be completed. In this case, the INP output will be turned OFF.



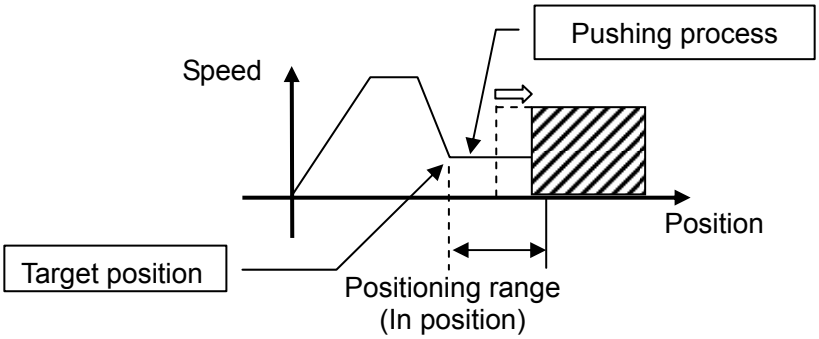
(3) Movement of the workpiece after the completion of the pushing process

1) Movement of the workpiece in the pushing direction

After completion of the pushing operation, if the reaction force from the workpiece becomes smaller, the actuator may move with a force smaller than that specified in the “TriggerLV” of the step data.

In this case, the INP output will be turned OFF and the actuator moves within the positioning range according to the balance of the force.

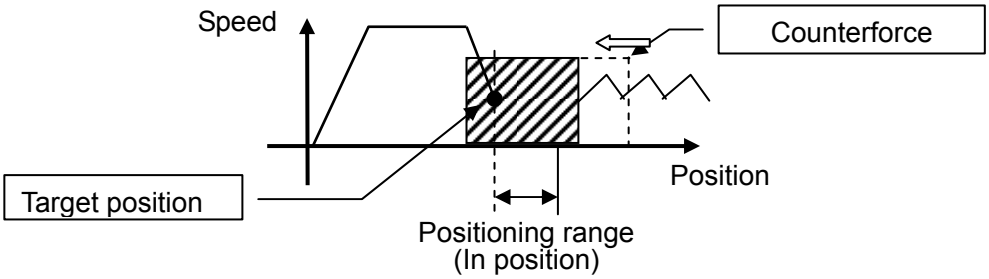
If the pushing force is kept higher than the value specified by “Trigger LV” of the step data for a certain time again, the INP output will be reactivated.



2) Movement of the workpiece in the direction opposite to the pushing direction

(The actuator is pushed back since the reaction force from the workpiece is too large.)

After completion of the pushing operation, if the reaction force from the workpiece becomes larger, the actuator may be pushed back. In this case, while the INP output is kept ON, the actuator will be pushed back to the point where the reaction force and the actuator pushing force are balanced (pushed back toward the target position). If the actuator is pushed back over the target position, the alarm (ORIG ALM) will be activated.



9.4 Controller input signal response time

The factors that may cause a delay in the controller's response to the input signal are as follows:

1) Delay in scanning the input signal.
2) Delay in analysis and computing of the input signal.
3) Delay in analysis and processing of the command.

Leave an interval of 15 ms (30 ms if possible) or more between input signals and maintain the state of the signal for 30ms or more, as PLC processing delays and controller scaning delays can occur.

9.5 Methods of interrupting operation

There are two methods of interrupting operation and stopping the actuator during positioning operation and pushing operation, as shown below. The state after stopping is different, so use the method appropriate to the application.

[Stopping by EMG signal]

If the EMG signal is turned OFF during operation, after the actuator decelerates and stops, the servo will turn OFF so the stopped position is not held. (For an actuator with lock, it is held by the lock function.)

[Stopping by RESET signal]

If the RESET signal is turned ON during operation, after the actuator decelerates and stops, the stopped position is held. (The servo does not turn OFF.)

[Stopped by HOLD signal]

The actuator decelerates to stop when HOLD signal is ON during operation.

⚠Caution
If instructed to stop by EMG signal and RESET signal, all OUT signals will turn OFF.

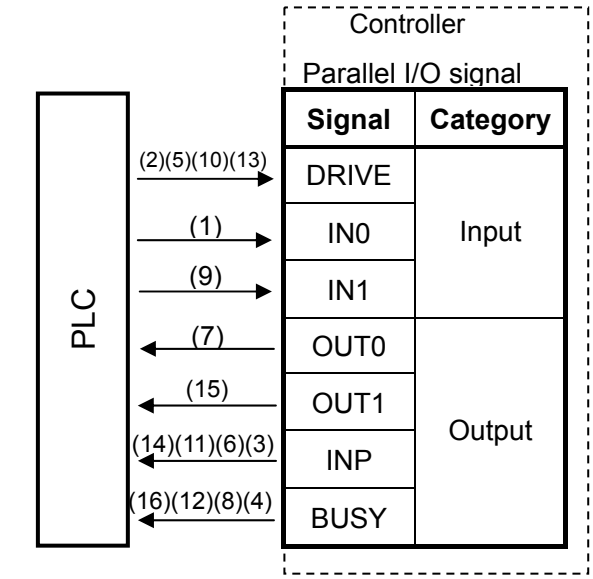
10. Operation (examples)

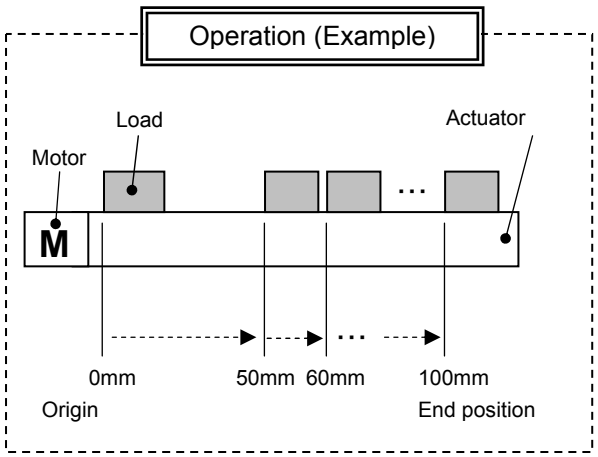
10.1 Positioning operation

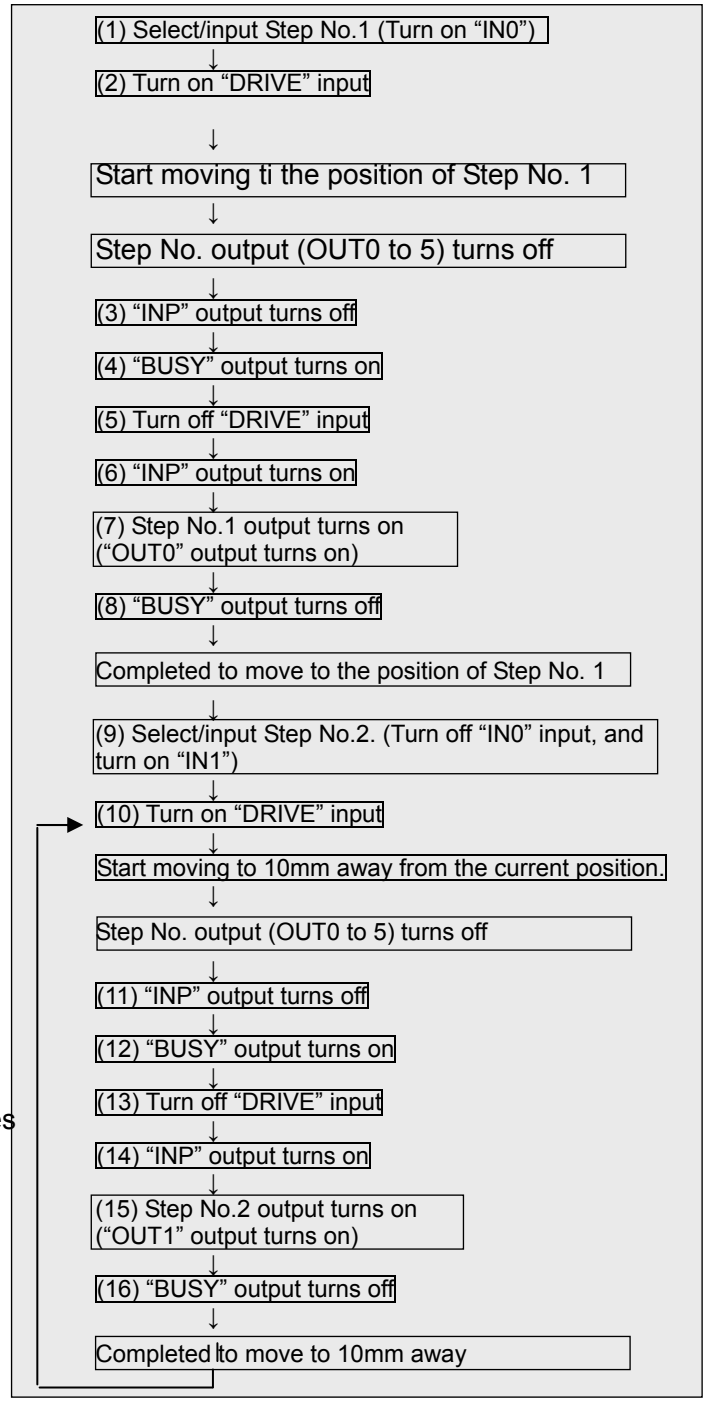
Example) Move an actuator from the origin to 50mm point at 100mm/s. (Using Step No.1)
Next, move the actuator from the 50mm point to 100mm point by moving it 5 times continuously, 10mm at a time, at a speed of 50 mm/s. (Step No. 2)

1. [Normal mode] Step data example

No.	Movement MOD	Speed mm/s	Position mm	Acceleration mm/s^2	Deceleration mm/s^2	Pushing force %	Trigger LV %	Pushing speed mm/s	Moving force %	Area1 mm	Area2 mm	In position mm
0	-	-	-	-	-	-	-	-	-	-	-	-
1	Absolute	100	50.00	1000	1000	0	0	0	100	0	0	0.1
2	Relative	50	10.00	1000	1000	0	0	0	100	0	0	0.1



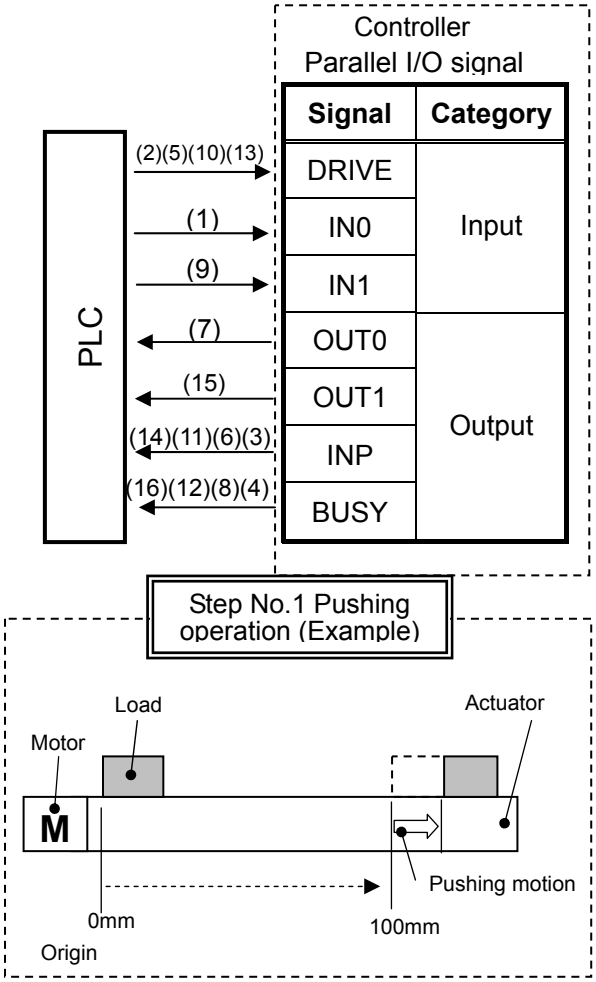




10.2 Pushing operation

Example) Move an actuator from the origin to 100mm point at 100mm/s. (Using Step No.1)
From the 100mm point, the actuator starts the pushing operation at a speed of 10mm/s and force of 50% or less (the pushing distance is up to 5mm). Then, the actuator moves from the position where the pushing operation was completed (where INP was turned on) to the 50mm point at 50mm/s. (Using Step No.2)
[Normal mode] Step data example

No.	Movement MOD	Speed mm/s	Position mm	Acceleration mm/s^2	Deceleration mm/s^2	Pushing force %	Trigger LV %	Pushing speed mm/s	Moving force %	Area1 mm	Area2 mm	In position mm
0	-	-	-	-	-	-	-	-	-	-	-	-
1	Absolute	100	100.00	1000	1000	50	40	10	100	0	0	5
2	Absolute	50	50.00	1000	1000	0	0	0	100	0	0	0.1



(1) Select/input Step No.1 (Turn on “IN0”)
↓
(2) Turn on “DRIVE” input
↓
Start moving to the position of Step No. 1
↓
Step No. output (OUT0 to 5) turns off
↓
(3) “INP” output turns off
↓
(4) “BUSY” output turns on
↓
(5) Turn off “DRIVE” input
↓
Move at low speed after passing the “position” of the Step No. 1
↓
Push the workpiece with the specified pushing force
↓
(6) “INP” output turns on
↓
(7) Step No.1 output turns on (“OUT0” output turns on)
↓
(8) “BUSY” output turns off
↓
Completed to move to the position of Step No.1)
↓
(9) Select/input Step No.2. (Turn off “IN0” input, and turn on “IN1”)
↓
(10) Turn on “DRIVE” input
↓
Start moving to 50mm away from the current position.
↓
Step No. output(OUT0 to 5) turns off
↓
(11) “INP” output turns off
↓
(12) “BUSY” output turns on
↓
(13) Turn off “DRIVE” input
↓
(14) “INP” output turns on
↓
(15) Step No.2 output turns on (“OUT1” output turns on)
↓
(16) “BUSY” output turns off
↓
Completed to move to the “Postion” of the Step No.2

11. Operation instructions

11.1 Operation procedure for the absolute controller

1. When the power is supplied for the first time. (Refer to [11.2.1 (1)])

   It is necessary to perform the return to origin position after resetting the two alarms.

   - When power is supplied for the first time with the electric actuator connected.
   - When the battery is replaced.
   - When the backup period has been exceeded (battery is completely discharged)

2. Recycle power (turn the power off and on again)

   (1) Recycle power (Normal condition) (Refer to [11.2.1(2)])

   - No alarm.
   - SetON turns ON.

   (2) With alarm (group C) when the power is reapplied (Refer to [11.2.1 (3)])

   - Alarm (group C) is generated.
   - SetON turns ON.

   (3) With alarm (group D) when the power is reapplied (Refer to [11.2.1 (4)])

   - Alarm (group D) is generated.
   - SetON turns OFF.

3. Alarm (group E) is cleared by power supply interruption. (Refer to [11.2.1(5)])

   - No alarm.
   - SetON turns OFF.

⚠ Caution

When you wish to check the hold of the electric gripper, please contact SMC .

11.2 Operation procedure of parallel I/O

Please refer to the following “Procedures” and “Timing chart” for each operation.

11.2.1 Power on → Return to origin

(1) When the power is supplied for the first time (including when the battery is completely discharged and when the battery is replaced)

- Procedure -

1) Supply power

↓

2) *ESTOP output turns on
*ALARM output is turned on once, then turned off after T1 passed.
([1-153: Absolute encoder ID does not match controller data] alarm is generated)

↓

3) RESET input turns on

↓

4) *ALARM output turns on once but, then quickly turns off.
([1-152: Abnormal absolute encoder] alarmis generated.
[1-107: Low Batt Voltage] alarm,
[1-154: Absolute encoder cable is not connected to the controller.] alarm is generated depending on the case)

↓

5) *ALARM OFF condition is checked after T3 has passed.

↓

6) RESET input turns on

↓

7) *ALARM turns on

↓

8) SVON input turns on

↓

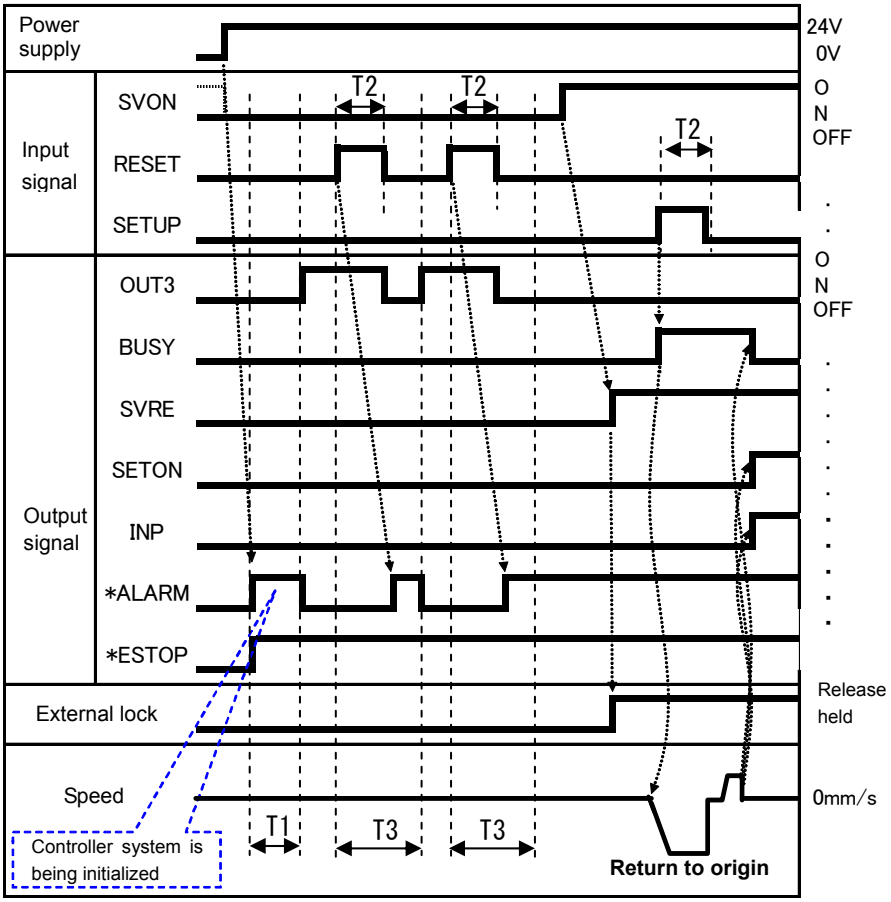
9) *ALARM OFF condition is checked after T3 has passed.

↓

10) SVRE output turns on
*The time taken for SVRE output to turn on depends on the actuator type and the operating conditions.
* Actuator with lock is unlocked.

↓

-Timing chart-



* ”*Alarm” and ”*ESTOP” are displayed in negative logic.
* “Power is ON” in the timing chart shows the power supply if ON.

T1: 1.6s or less (System initialize time Time required to activate alarm)
T2: 15ms or longer (Recommendation 30ms) (RESET input, SETUP input)
T3: 300ms or less (ALARM inspection time)

11) SETUP input turns on

↓

12) BUSY output turns on

(Starts)

↓

13) SETON, INP output turns on

Return to origin is completed when BUSY output is turned off
When return to home position is completed, .
DRIVE etc. is available.

(2) Power ON(Normal)

If [*ALARM] is ON (no alarm) in T1 after supplying power again, SETON output is ON after T4.

- Procedure -

1) Supply power

↓

2) *ESTOP output turns on

*ALARM output turns on

↓

3) SETON output turns on after T4 passed

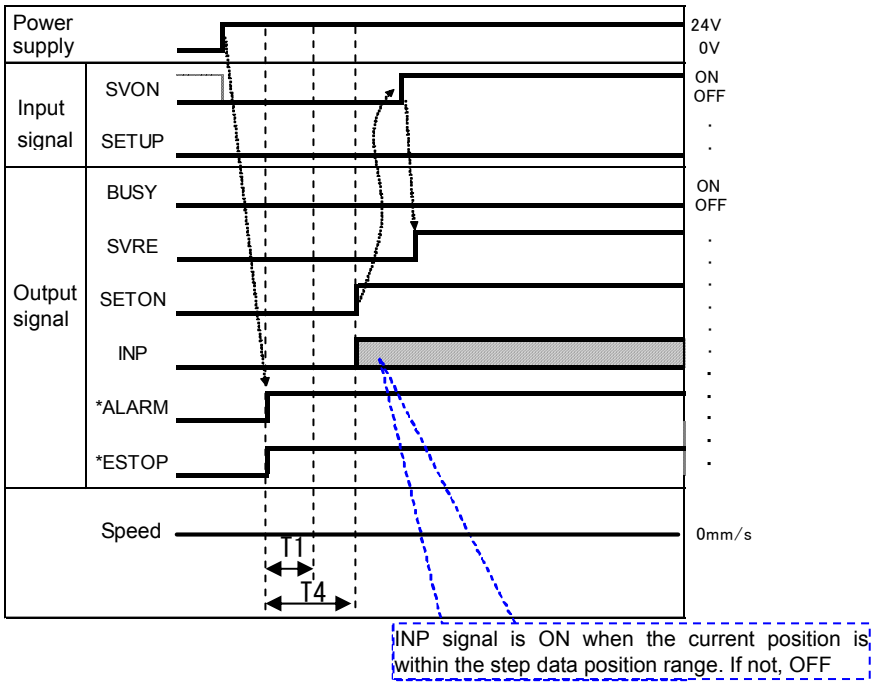
↓

4) SVON input turns on

↓

5) SVRE output turns on and the returning action is completed
Afterwards, DRIVE etc. is available.

-Timing chart-



* "*Alarm" and "*ESTOP" are displayed in negative logic.
* "Power is ON" in the timing chart shows the power supply if ON.

T1: 1.6s or less (System initialize time + Time required to activate alarm)

T4: 3s or less (System initialize time + Time required to activate alarm + Position data recovery time)

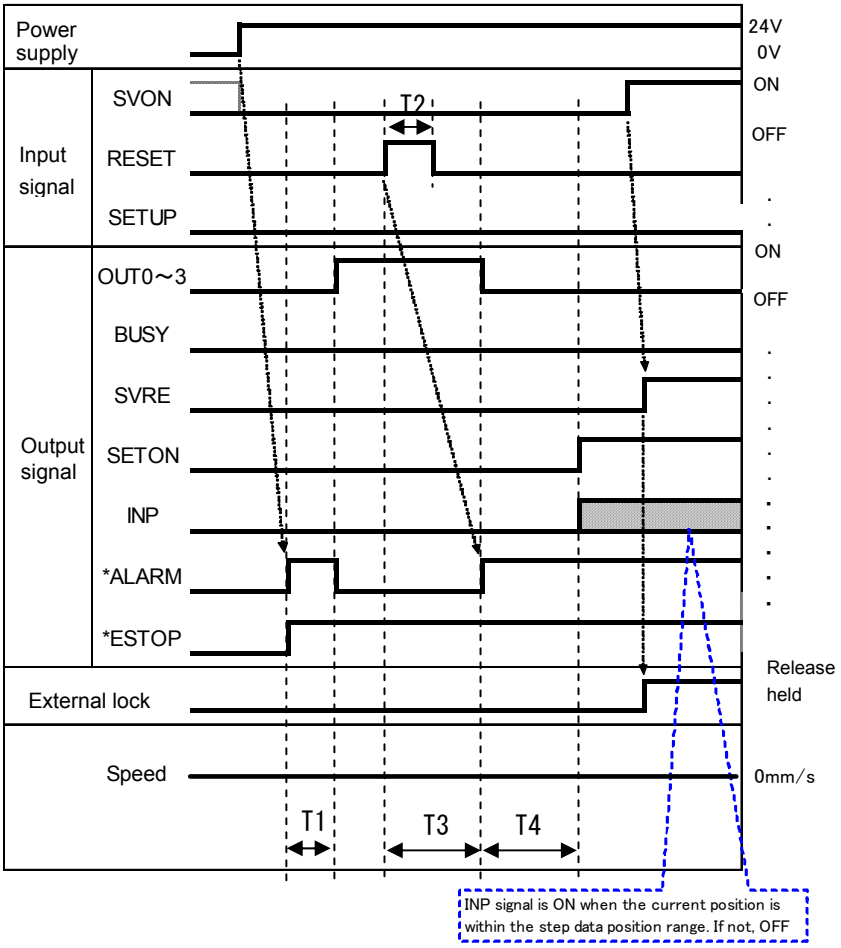
(3) With alarm (group C) when the power is supplied after initial power on

If [*ALARM] is OFF (alarm is generated) in T1 after supplying power again, SETON output is not ON.
In this case, it is necessary to eliminate the cause of the alarm, reset the alarm to turn on SETON output.

- Procedure -

1) Supply power
↓
2) *ESTOP output turns on
*ALARM output is turned on once, then turned off after T1 passed.
↓
3) RESET input turns on
↓
4) SETON output turns on after T4 passed
↓
5) SVON input turns on
↓
6) SVRE output turns on and the Returning action is completed. Afterwards, DRIVE etc. is available.

-Timing chart-



* "*Alarm" and "*ESTOP" are displayed in negative logic.
* "Power is ON" in the timing chart shows the power supply if ON.

T1: 1.6s or less (System initialize time + Time required to activate alarm)
T2: 15ms or longer (Recommendation 30ms) (RESET input, SETUP input)
T3: 300ms or less (ALARM inspection time)
T4: 3s or less (System initialize time + Time required to activate alarm + Position data recovery time)

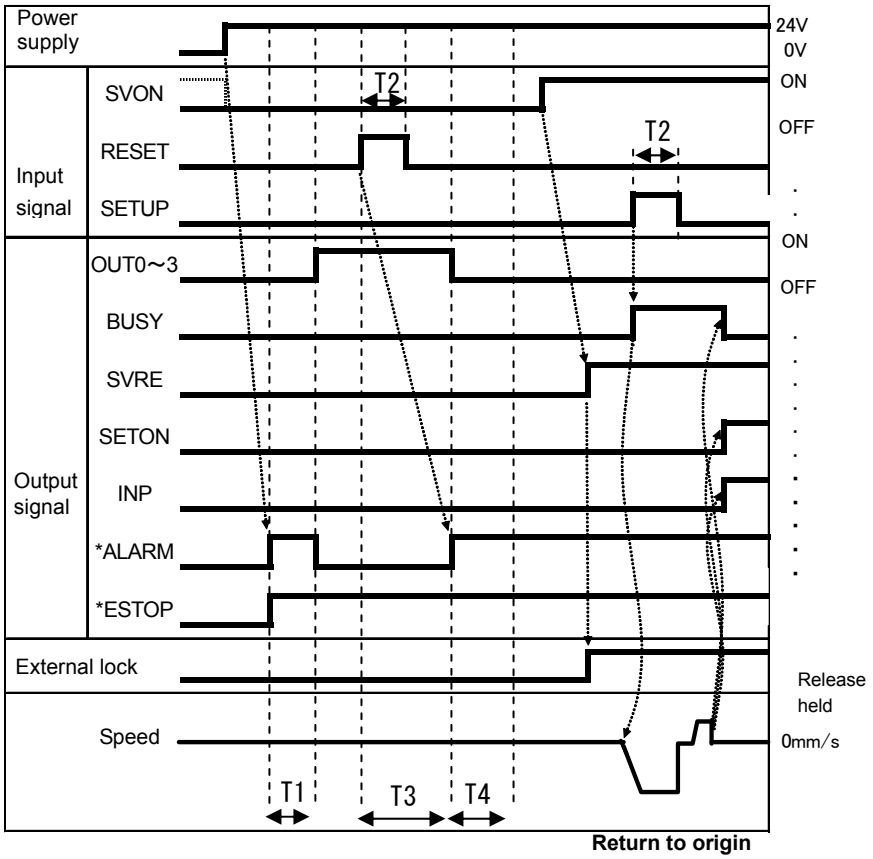
(4) With alarm (group D) when the power is supplied after initial power on

If [*ALARM] is OFF (alarm is generated) in T1 after supplying power again, SETON output is not ON.
In this case, it is necessary to eliminate the cause of the alarm, reset the alarm and perform the return to origin position.

- Procedure -

1) Supply power
↓
2) *ESTOP output turns on
*ALARM output is turned on once, then turned off after T1 passed.
↓
3) RESET input turns on
↓
4) SETON output turns off after T4 passed
↓
5) SVON input turns on
↓
6) SVRE output turns on
*The time taken for SVRE output to turn on depends on the actuator type and the operating conditions.
* Actuator with lock is unlocked.
↓
7) SETUP input turns on
↓
8) BUSY output turns on
（Starts）
↓
9) SETON, INP output turns on
Return to origin is completed when BUSY output is turned off
Afterwards, DRIVE etc. is available.

-Timing chart-



* "*Alarm" and "*ESTOP" are displayed in negative logic.
* "Power is ON" in the timing chart shows the power supply if ON.

T1: 1.6s or less (System initialize time ＋ Time required to activate alarm)
T2: 15ms or longer (Recommendation 30ms)(RESET input, SETUP input)
T3: 300ms or less (ALARM inspection time)
T4: 3s or less (System initialize time ＋ Time required to activate alarm + Position data recovery time)

⚠ Caution

Alarm is generated twice when battery replacement is necessary or the battery is completely discharged (group D). In this case, perform "11.2.1 (1) When the power is supplied for the first time ",

(5) Power supply is interrupted due to alarm (group E)

It is necessary to return to origin when alarm (group E) is generated and the alarm is cleared by recycling the power supply

- Procedure -

1) Supply power

↓

2) *ALARM output turns on

*ESTOP output turns on

↓

3) SVON input turns on after T1 passed

↓

4) SVRE output turns on

*The time taken for SVRE output to turn on depends on the actuator type and the operating conditions.

* Actuator with lock is unlocked.

↓

5) SETUP input turns on

↓

6) BUSY output turns on

（Starts）

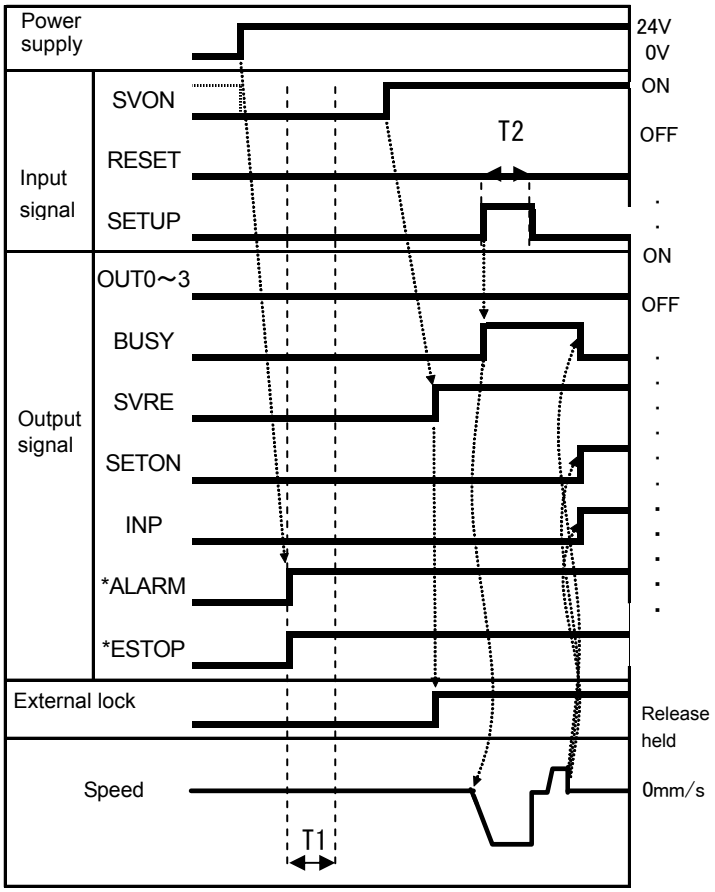
↓

7) SETON, INP output turns on

Return to origin is completed when BUSY output is turned off

Afterwards, DRIVE etc. is available.

-Timing chart-



Return to origin

* "*Alarm" and "*ESTOP" are displayed in negative logic.
* "Power is ON" in the timing chart shows the power supply if ON.

T1: 1.6s or less (System initialize time ＋ Time required to activate alarm)

T2: 15ms or longer (Recommendation 30ms) (SETUP input)

11.2.2 Positioning operation

- Procedures-

1) Input step data No. (IN0 to IN5)

↓

2) DRIVE is turned ON.

→Scan the step data number (from IN0 to IN5).

* Then, if DRIVE is turned OFF, the step data number will be output (from the output OUT0 to OUT5).

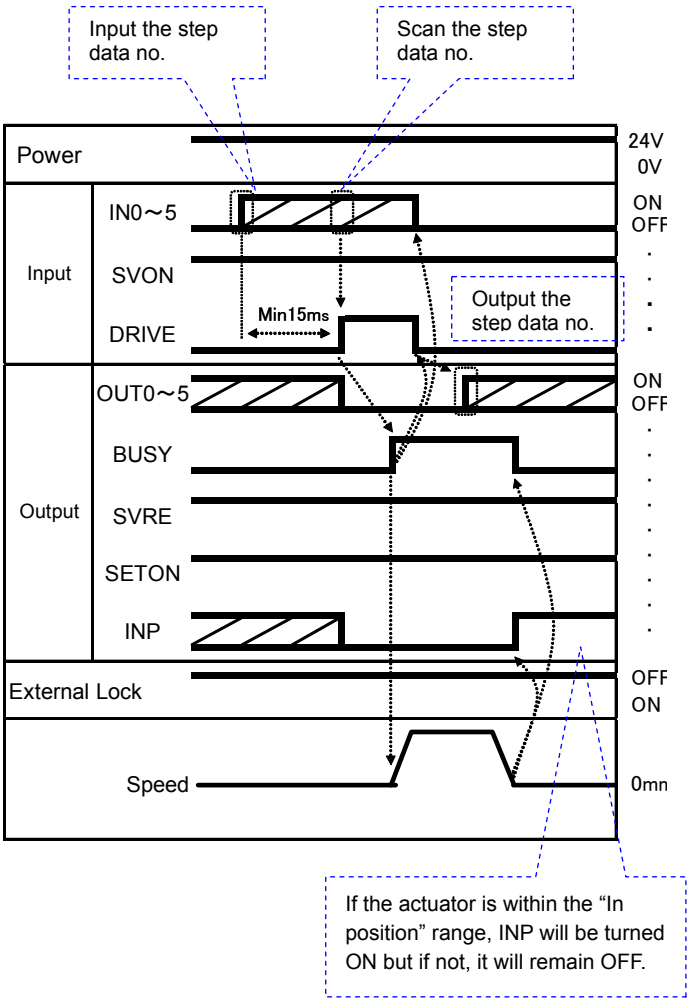
↓

3) BUSY is turned ON.

(The positioning operation starts.)

↓

4) When INP turns ON and BUSY turns OFF, the positioning operation will be completed.



11.2.3 Pushing operation

- Procedures-

1) Input step data No. (IN0 to IN5)

↓

2) DRIVE is turned ON. (OUT0-5 is turned off.)

→Scan the step data number (from IN0 to IN5).

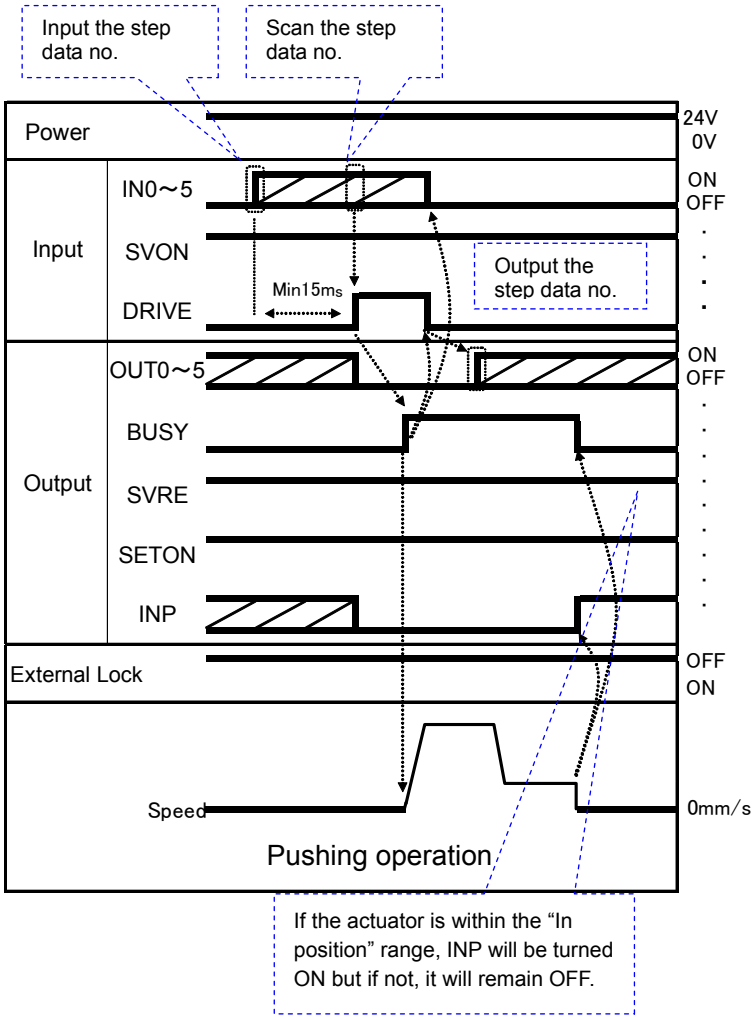
* After this, if DRIVE is turned OFF, the step data number will be output (from the outputs OUT0 to OUT5).

↓

3) BUSY is turned ON.

↓

4) When INP output is turned ON and BUSY is turned OFF, the pushing operation will be completed (the actuator generates the force larger than that specified in “TriggerLV” of the step data).



11.2.4 HOLD

-Procedures-

1) HOLD is turned ON during the operation (when HOLD is ON).

↓

2) BUSY is turned OFF (the actuator stops).

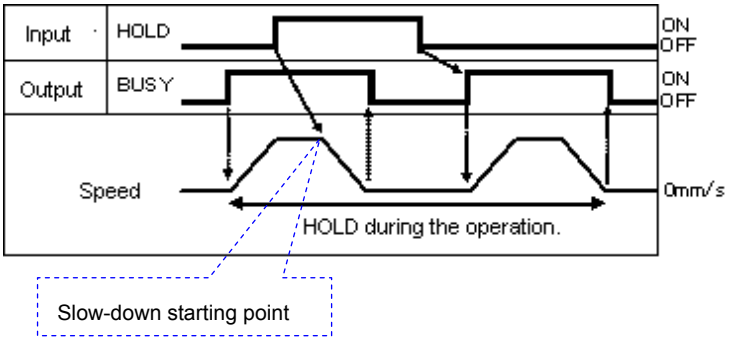
↓

3) HOLD is turned OFF.

↓

4) BUSY is turned ON (the actuator restarts).

-Timing chart-



11.2.5 Reset

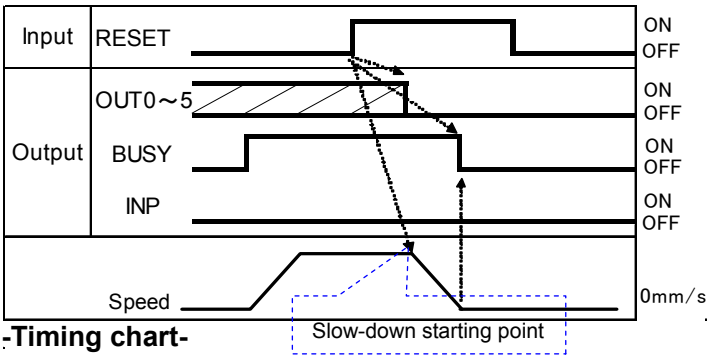
-Procedures- [Driving reset]

1) RESET is turned ON during the operation (BUSY output is ON).

↓

2) BUSY output, OUT0 to OUT3 output is OFF.

-Timing chart- Driving reset



-Timing chart-

* If the actuator is within the “In position” range, INP will be turned ON.

-Procedures- [Alarm reset]

1) An alarm is activated(ALARM is turned OFF and the output OUT0 to OUT3 is turned ON.)

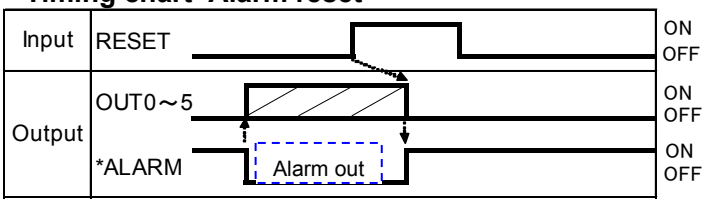
↓

2) RESET is turned ON.

↓

3) ALARM is turned ON and the output OUT0 to OUT3 is turned OFF (the alarm is deactivated).

-Timing chart- Alarm reset



-Timing chart-

* The “ALARM” is expressed as negative-logic circuit.

11.2.6 Stop

-Procedures-

1) The stop [EMG] input is turned OFF during the operation (when BUSY is ON). [stop command]

↓

2) ESTOP is turned OFF.

↓

3) BUSY is turned OFF (the actuator stops).
SVRE is turned OFF (if the actuator has a lock).

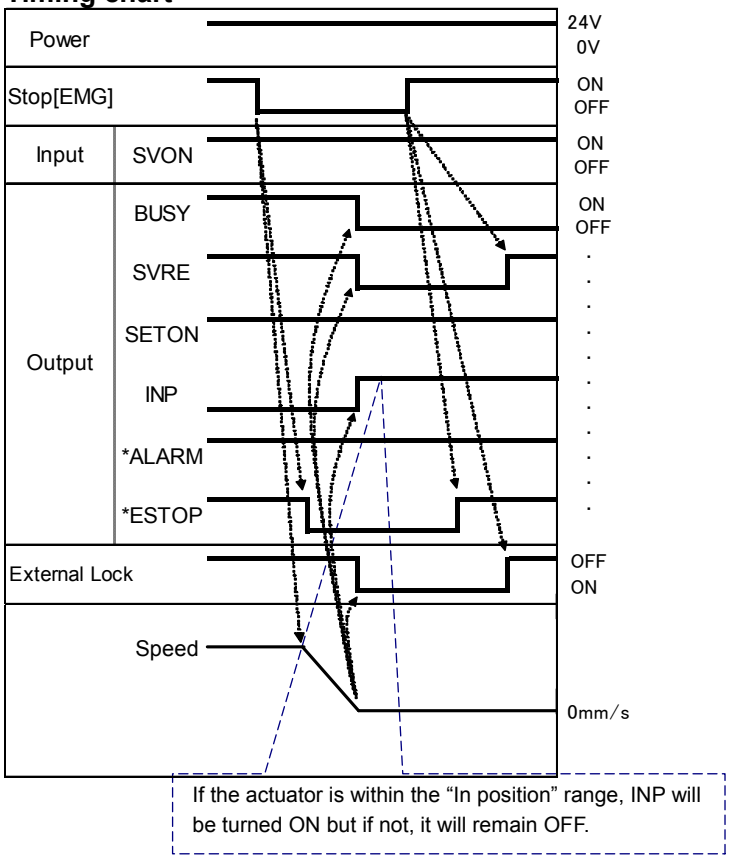
↓

4) The stop [EMG] input is turned ON.
[The stop release command]

↓

5) ESTOP is turned ON.
* SVRE is turned ON. (lock release)
(* If the actuator has a lock.)

-Timing chart-



* The “ALARM” and “ESTOP” are expressed as negative-logic circuit.

* When "Stop" is OFF, the stop is activated.

11.2.7 Area output

-Procedures-

* Operation of Step Data No.1

1) Input step data No. (IN0 to IN5).

↓

2) DRIVE is turned ON.

→ Receive the step data no.1 (from the input IN0 to IN5).

* Then, if the DRIVE is turned OFF, the step data will be output (from the output OUT0 to OUT5).

↓

3) BUSY is turned ON.

(The actuator starts the operation).

INP is turned OFF.

↓

4) AREA output is turned ON for the step data no.1 (at 150mm from the origin point).

↓

5) BUSY is turned OFF.

(The actuator stops.)

INP is turned ON.

↓

* Operation of Step Data No.2

6) Input step data No. (IN0 to IN5).

↓

7) DRIVE is turned ON.

→ Receive the step data no.2 (from the input IN0 to IN5).

* Then, if the DRIVE is turned OFF, the step data will be output (from the output OUT0 to OUT5).

↓

8) AREA is turned OFF.

BUSY is turned ON. (The actuator starts the operation.)

↓

9) AREA output is turned ON for the step data no.2 (at 170mm from the origin point).

↓

10) AREA output is turned OFF for the step data no.2 (at 130mm from the origin point).

↓

11) BUSY is turned OFF.

(The actuator stops.)

INP is turned ON.

-Timing chart-

Example:

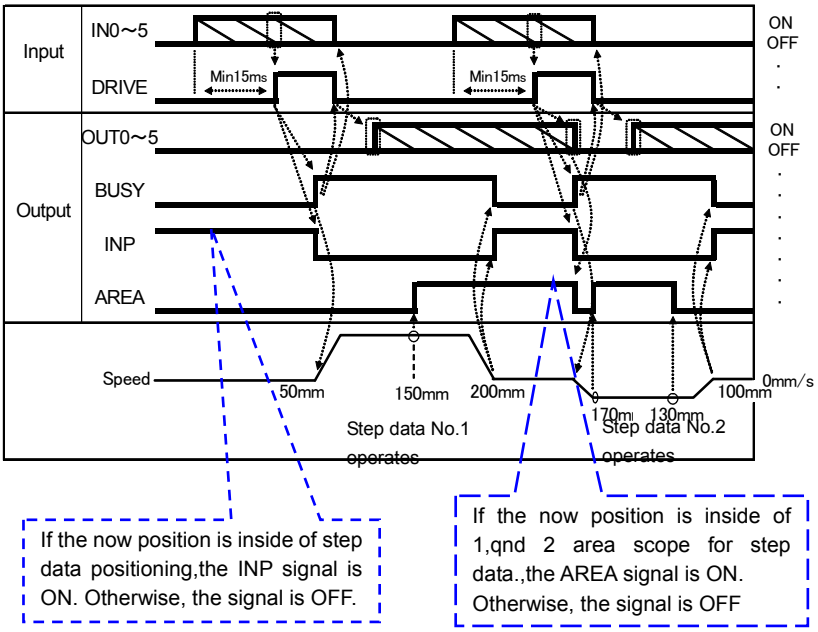
The initial position: 50mm

↓

Operation of step data No.1: Position: 200mm, Area1-Area2: 150-250mm

↓

Operation of step data No.2: Position: 100mm, Area1-Area2: 130-170mm



12. Options

12.1 Actuator cable (5m or less)

LE - CP - □ - □

Cable length (L)

1	1.5m
3	3m
5	5m

Actuator cable type

Nil	Robot cable
S	Standard cable

①

signal	Tarminal no.
A	B-1
$\overline{A}$	A-1
B	B-2
$\overline{B}$	A-2
COM-A/COM	B-3
COM-B/ -	A-3
Vcc	B-4
GND	A-4
$\overline{A}$	B-5
A	A-5
$\overline{B}$	B-6
B	A-6

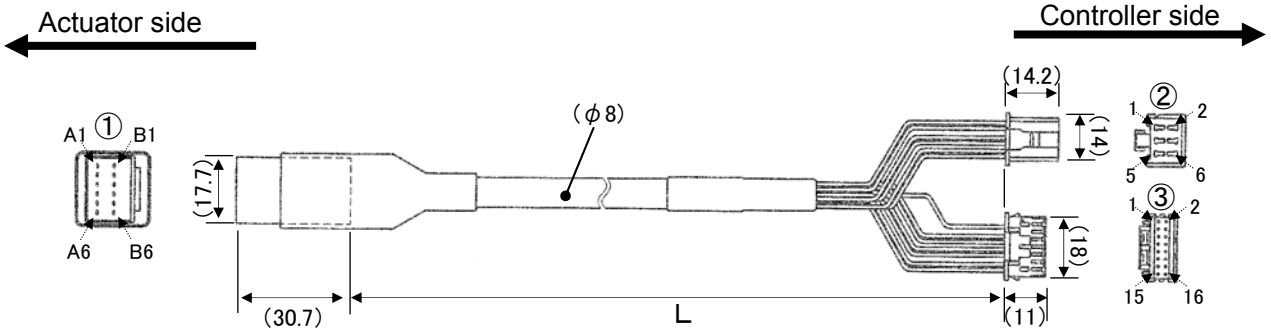
Shield

②

Cable color	Tarminal no.
Brown	2
Red	1
Orange	6
Yellow	5
Green	3
Blue	4

③

Cable color	Tarminal no.
Brown	12
Black	13
Red	7
Black	6
Orange	9
Black	8
-	3



12.2 Actuator cable (8-20m)

LE - CP - □

Cable length (L)

8	8m*
A	10m*
B	15m*
C	20m*

*produced upon receipt of order

* Only "Robotic type cable" can be selected.

①

signal	Tarminal no.
A	B-1
$\overline{A}$	A-1
B	B-2
$\overline{B}$	A-2
COM-A/COM	B-3
COM-B/ -	A-3
Vcc	B-4
GND	A-4
$\overline{A}$	B-5
A	A-5
$\overline{B}$	B-6
B	A-6

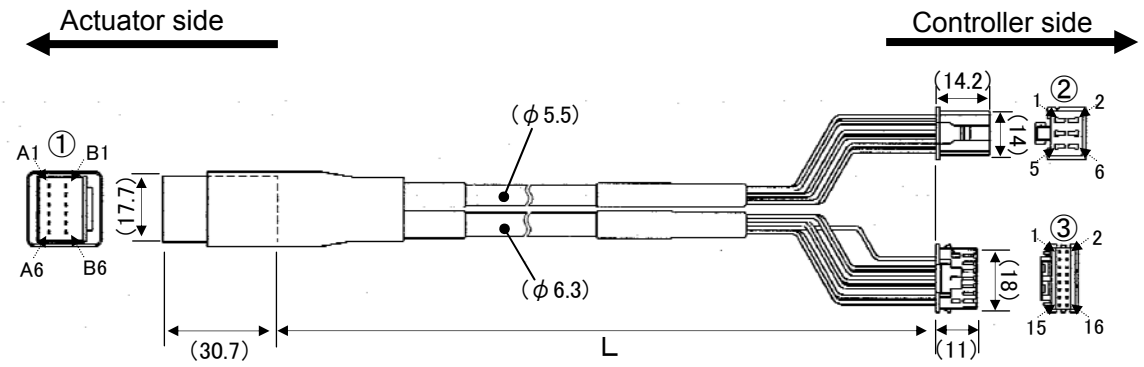
Shield

②

Cable color	Tarminal no.
Brown	2
Red	1
Orange	6
Yellow	5
Green	3
Blue	4

③

Cable color	Tarminal no.
Brown	12
Black	13
Red	7
Black	6
Orange	9
Black	8
-	3



12.3 Actuator cable for with lock (5m or less)

LE - CP - □ - B - □

Cable length (L)

1	1.5m
3	3m
5	5m

Actuator cable type

Nil	Robot cable
S	Standard cable

①

signal	Tarminal no.
A	B-1
$\overline{A}$	A-1
B	B-2
$\overline{B}$	A-2
COM-A/COM	B-3
COM-B/ -	A-3

②

Cable color	Tarminal no.
Brown	2
Red	1
Orange	6
Yellow	5
Green	3
Blue	4

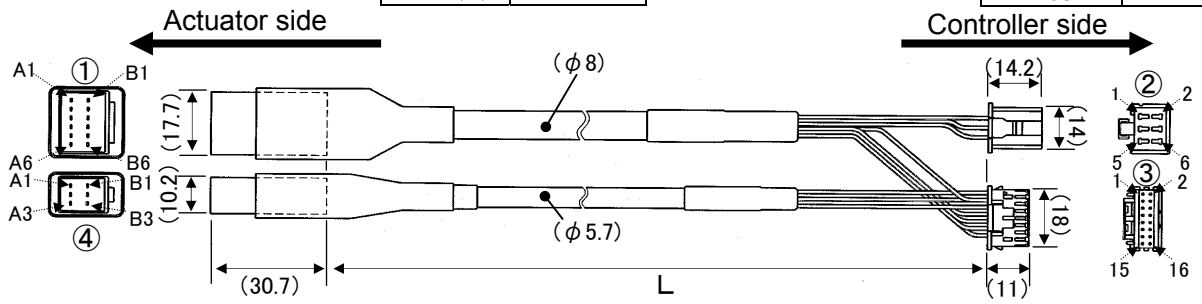
Shield

③

signal	Tarminal no.	Cable color	Tarminal no.
Vcc	B-4	Brown	12
GND	A-4	Black	13
$\overline{A}$	B-5	Red	7
A	A-5	Black	6
$\overline{B}$	B-6	Orange	9
B	A-6	Black	8
		-	3

④

signal	Tarminal no.	Cable color	Tarminal no.
Lock(+)	B-1	Red	4
Lock(−)	A-1	Black	5
Sensor(+)	B-3	Brown	1
Sensor(−)	A-3	Blue	2



12.4 Actuator cable for with lock (8-20m)

LE - CP - □ - B

Cable length (L)

8	8m*
A	10m*
B	15m*
C	20m*

*produced upon receipt of order

* Only "Robotic type cable" can be selected.

①

signal	Tarminal no.
$\overline{A}$	B-1
A	A-1
$\overline{B}$	B-2
B	A-2
COM-A/COM	B-3
COM-B/ -	A-3

②

Cable color	Tarminal no.
Brown	2
Red	1
Orange	6
Yellow	5
Green	3
Blue	4

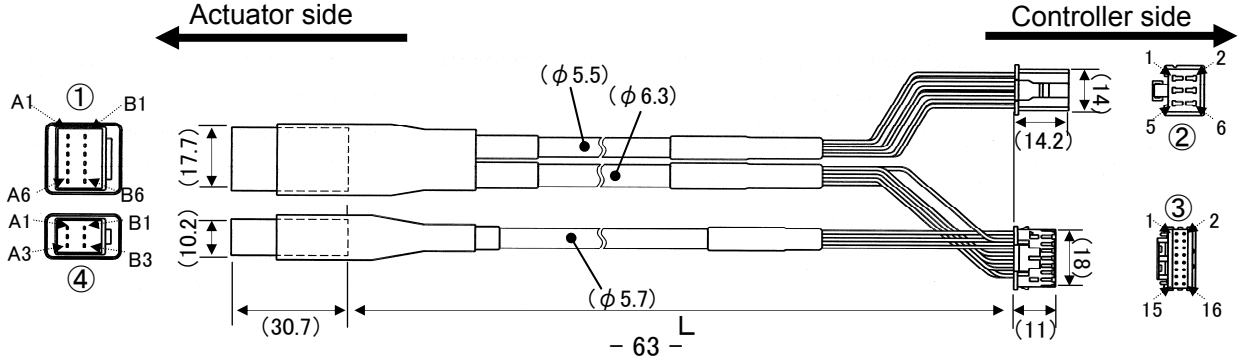
Shield

③

signal	Tarminal no.	Cable color	Tarminal no.
Vcc	B-4	Brown	12
GND	A-4	Black	13
$\overline{A}$	B-5	Red	7
A	A-5	Black	6
$\overline{B}$	B-6	Orange	9
B	A-6	Black	8
		-	3

④

signal	Tarminal no.	Cable color	Tarminal no.
Lock(+)	B-1	Red	4
Lock(−)	A-1	Black	5
Sensor(+)	B-3	Brown	1
Sensor(−)	A-3	Blue	2



12.5 I/O Cable

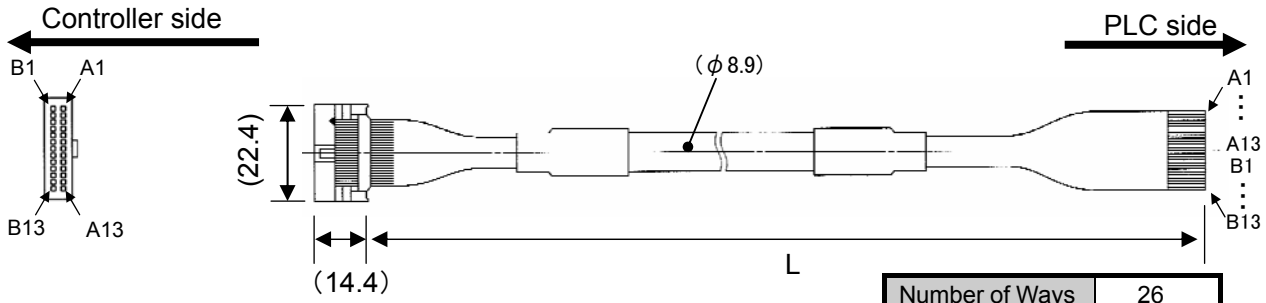
LEC – CN5 – □

Cable length(L)

1	1.5m
3	3m
5	5m

Pin No.	# of wire	Color of insulation	Dot mark	Dot color
A1	1	Light brown	■	Black
A2		Light brown	■	Red
A3	2	Yellow	■	Black
A4		Yellow	■	Red
A5	3	Light green	■	Black
A6		Light green	■	Red
A7	4	Grey	■	Black
A8		Grey	■	Red
A9	5	White	■	Black
A10		White	■	Red
A11	6	Light brown	■■	Black
A12		Light brown	■■	Red
A13	7	Yellow	■■	Black

Pin No.	# of wire	Color of insulation	Dot mark	Dot color
B1	7	Yellow	■■	Red
B2	8	Light green	■■	Black
B3		Light green	■■	Red
B4	9	Grey	■■	Black
B5		Grey	■■	Red
B6	10	White	■■	Black
B7		White	■■	Red
B8	11	Light brown	■■■	Black
B9		Light brown	■■■	Red
B10	12	Yellow	■■■	Black
B11		Yellow	■■■	Red
B12	13	Light green	■■■	Black
B13		Light green	■■■	Red
-	Shield			



Number of Ways	26
AWG	AWG28

12.6 Controller setting kit

LEC – W2

Controller setting kit

Contents

(1) Controller setting software (CD-ROM)
(2) Communication cable
(3) Conversion unit
(4) USB cable

Hardware requirements

PC/AT compatible machine installed with Windows XP® and Windows 7® and equipped with USB1.1 or USB2.0 ports.

*Windows® and Windows XP®, Windows 7® are registered trade marks of Microsoft Cornporation.

⚠ Caution

The latest version of the controller setting software must be used.
Upgrade software can be downloaded from SMC website. http://www.smcworld.com/

12.7 Teaching box

LEC – T1 – 3 E G □

Teaching box

Cable length

3	3m

Initial language

E	English
J	Japanese

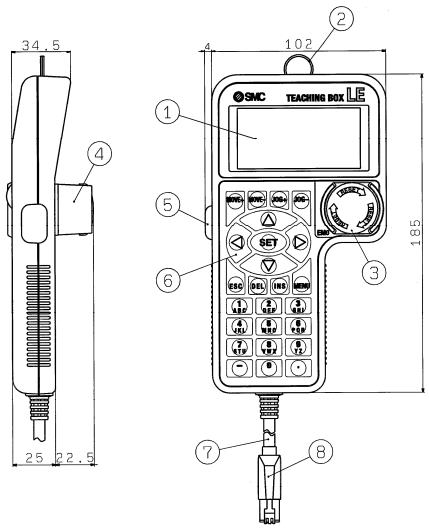
Stop switch

G	Equipped with stop switch

Enable switch

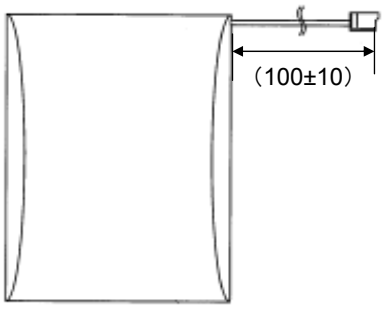
Nil	No enable switch
S	Equipped with enable switchch

Dimensions



No	Name	Function
(1)	LCD	Liquid crystal display (with backlight)
(2)	Ring	The ring to hang the teaching box.
(3)	Stop switch	.When the switch is pressed, the switch locks and it stops. Turn clockwise to release the lock.
(4)	Stop guard	Protector for the stop switch
(5)	Enable switch (Option)	Switch to prevent unintentional operation of Jog test function. * Does not apply to other functions e.g. data change
(6)	Key switch	Entry switches
(7)	Cable	3m length
(8)	Connector	The connector to be connected to the CN4 of the controller

12.8 Battery



LE-BP-X22

	Function
Battery	Nickel-Metal Hydride secondary battery 3.6V Battery Charge time: 72 hours
Weight	About 190g

13. Alarm Detection

13.1 Parallel output for the alarm group

This product outputs a signal to distinguish the type of the alarm when an alarm is generated.

Alarms are classified into 5 groups. When an alarm is generated, it is output in OUT0 to 3.

Refer to the table below for the combination of the alarm group and the output terminals.

Alarm group	Parallel signal output.				
	*ALARM	OUT0	OUT1	OUT2	OUT3
Alarm group A	OFF	ON	OFF	OFF	OFF
Alarm group B	OFF	OFF	ON	OFF	OFF
Alarm group C	OFF	OFF	OFF	ON	OFF
Alarm group D	OFF	OFF	OFF	OFF	ON
Alarm group E	OFF	OFF	OFF	OFF	OFF

「*ALARM」 is displayed in negative

After generation of the alarm, SVRE or SETON are output according to the contents of the alarm as shown below.

Alarm group	Parallel signal		How to start test run.
	SVRE	SETON	
Alarm group A	No	No	Input RESET
Alarm group B	No	No	Input RESET
Alarm group C	No	No	Input RESET
Alarm group D	OFF	ON (*1)	Input RESET (*2)
Alarm group E	OFF	OFF	Power supply for control is turned off --> Supply again

*1: SETON is ON when the the power is supplied for alarm group D of Absolute Controller "11. 2. Refer to 11.2.1 (4) With alarm (group D).

*2: Input "RESET" ⇒ 『SVRE』: Automatically ON (when SVON is ON)

⚠ Caution

Check the contents of alarm referring to "code (code number)" for the controller setting software.

13.2 Alarm details

* Alarm for absolute controller (Refer to the part marked with)

Alarm (code)	Teaching box Description	Group	How to deactivate	Alarm contents / Countermeasure
Drive data value is wrong (1-048)	Step dataALM1	B	Input RESET	**<Contents>**The step data is incorrect for the following conditions (Assignable value range) (1) Area1 < Area2 (If both Area1 and Area2 is 0, the alarm will not be activated.) (2) Trigger LV ≤ Pushing force (3) Minimum speed of actuator ≤ Pushing speed ≤ Speed (4) Pushing speed ≤ Maximum pushing speed of actuator (5) Pushing force ≥ Minimum pushing force of actuator (6) Basic parameters “Max force” ≥ Minimum pushing force of actuator (7) Basic parameters “Max force” ≥ Trigger LV **<Countermeasure>** Modify the step data and basic parameters setting. **⚠ Caution** Please refer to the manual or the catalogue of the actuator for the max/min pushing force/speed for the actuator.
Parameter value is wrong (1-049)	Parameter ALM	B	RESET	**<Contents>** The basic parameter is not correct for the following condition:(Assignable value range) (1) Stroke (-) < Stroke (+) (2) W-Area 1 < W-Area2 (* If both W-Area1 and W-Area2 is 0, the alarm will not be activated.) (3) Maximum pushing force < Maximum pushing force of actuator **<Countermeasure>** Modify the basic parameter setting. **⚠ Caution** Please refer to the manual or the catalogue of the actuator for the max/min pushing force/speed for the actuator.
Set deceleration value is too small. (1-050)	Small Dec	B	Input RESET	**<Contents>** For an operation for a specific step data no., the actuator cannot stop within the stroke limit due to the value set for the “Deceleration” of the step data. **<Countermeasure>** Modify the Deceleration value to a value with a sufficient margin so that the actuator can stop within the stroke limit.

Alarm (code)	Teaching box Description	Group	How to deactivate	Alarm contents / Countermeasure
Set step data is not registered on list. (1-051)	Step dataALM2	B	RESET input	**<Contents>** For an operation for a specific step data no., the requested number of the step data is not registered. (When operation is commanded through PLC, this alarm will be generated depending on the input signal interval and the holding time of signals) **<Countermeasure>** (1) Make sure that the "Movement MOD" of the step data is not "Blank (Disabled)". (2) Process delay of PLC or scanning delay of the controller may occur. Keep the input signal combination for 15 ms (30 ms if possible) or longer. **Refer to 11.2.2 Positioning operation**
Set stroke is outside stroke limit. (1-052)	Stroke limit	B	RESET input	**<Contents>** The actuator goes outside the stroke limit specified by the basic parameters, "Stroke (+)" and "Stroke (-)" if it performs the requested operation. (Including JOG operation after return to origin) **<Countermeasure>** Make sure that the basic parameters, "Stroke (+)" and "Stroke (-)" are consistent with the distance of actuator movement specified in the step data. **⚠ Caution** If the operation method of step data is "relative coordinated movement", note the location where the operation starts and the distance travelled. If the location is out of the stroke range when the power is supplied, this alarm is generated. Move the table within stroke range, and supply power.
Reacting force is outside limit when pushing. Position is unstable. (1-096)	Pushing ALM	C	Input RESET	**<Contents>** In the pushing operation, the actuator is pushed back from the pushing operation origin position. . **<Countermeasure>** Increase the distance from the pushing operation origin position to the object being pushed. Or, increase the pushing force.
Return to ORIG has not completed in the set time. (1-097)	ORIG ALM	C	RESET input	**<Contents>** Return to origin is not completed within the set time. **<Countermeasure>** Check whether the movement of the actuator is obstructed.

Alarm (code)	Teaching box Description	Group	How to deactivate	Alarm contents / Countermeasure
Drive is ON when SVRE is OFF (1-098)	Servo off ALM	C	Input RESET	**<Contents>** While the servo motor is off, the return to origin operation, positioning operation, pushing operation or JOG operation is requested. **<Countermeasure>** Modify the setting so that those operations will be requested while the servo motor is ON (the SVON input is ON).
Drive is ON when SETON is OFF (1-099)	Drive ALM	C	Input RESET	**<Contents>** A positioning operation or pushing operation is requested beforethe return to origin position is completed. **<Countermeasure>** Modify the setting so that these operations will be requested after the return to origin position is completed.
Motor was not stationary when ABS encoder was communicating. (1-101)	AbEnc dataALM	C	Input RESET	**<Contents>** Actuator started by external force while power was supplied (while the controller was initialized). **<Countermeasure>** Do not start the actuator with external force when power is supplied.

<table>
<tr><th>Alarm (code)</th><th>Teaching box Description</th><th>Group</th><th>How to deactivate</th><th>Alarm contents / Countermeasure</th></tr>
<tr><td>Did not detect sensor when returning to ORIG.
(1-103)</td><td>ORIG Sens ALM</td><td>C</td><td>Input RESET</td><td><Contents> Return to origin parameter has the conditions shown below.
<table><tr><th></th><th colspan="2">Parameter setting content</th></tr><tr><th></th><th>ORIG mode</th><th>ORIG sensor</th></tr><tr><td>1</td><td>Pushing origin operation [Stop]</td><td>1. N.O</td></tr><tr><td>2</td><td>Limit switch origin [Sensor]</td><td>0. Disable
or
1. N.O</td></tr></table>* Alarm is generated with the conditions above when the sensor is not mounted to the actuator.
<Countermeasure> Check the sensor installation and settings of the return to origin parameter.</td></tr>
<tr><td>Battery is not connected to the controller
(1-104)</td><td>No AbEnc Batt</td><td>C</td><td>Input RESET</td><td><Contents> Battery is not connected to the controller
<Countermeasure> Check the connection to the battery
<table><tr><th>⚠ Caution</th></tr><tr><td>Absolute ID does not match (Initial condition) alarm is generated before this alarm.</td></tr></table></td></tr>
<tr><td>Battery temparature exceeded set value
(1-105)</td><td>Over BattTemp</td><td>C</td><td>Input RESET</td><td><Contents> The alarm is generated when the battery temperature is too high.
<Countermeasure>
Adjust the ambient temperature of the controller.</td></tr>
<tr><td>Absolute encoder communication error.
(1-106)</td><td>AbEnc CommALM</td><td>C</td><td>Input RESET</td><td><Contents> The alarm is generated when the communication between the controller circuit and the absolute circuit is not normal.
<Countermeasure> Check whether there is a possibility of noise in the operating environment.</td></tr>
</table>

Alarm (code)	Teaching box Description	Group	How to deactivate	Alarm contents / Countermeasure
Low Battery voltage (1-107)	Low Batt Vol	C	Input RESET	**<Contents>** The alarm is generated when the battery voltage drops. **<Countermeasure>** Verify that the period (backup) switch is set correctly. If the alarm reoccurs even after supplying power for 72 consecutive hours, replace the battery. **⚠ Caution** 「153:Absolute encoder ID does not match controller data」 alarm is generated before this alarm, or「152: Abnormal absolute encoder」 alarm is generated simultaneously.
Speed exceeded set value (1-144)	Over speed	D	RESET Input SVON (*1)	**<Contents>** The motor speed exceeds a specific level due to an external force, etc. **<Countermeasure>** Make improvements so that the motor speed will not exceed the maximum speed of the actuator. **⚠ Caution** Please refer to the manual or the catalogue of the actuator for the maximum speed of the actuator.
Motor power supply voltage is out side set range. (1-145)	Over motorVol	D	RESET Input SVON (*1)	**<Contents>** The motor power supply voltage is out of range during [SVON] . **<Countermeasure>** Make sure that the voltage supplied to the motor power (M24V) of the controller is within specification. **⚠ Caution** If the power supply is “inrush-current control type” , a voltage drop may cause an alarm during acceleration/ deceleration. **<Contents>** The alarm may be caused by regenerative power depending on the method of operation of the actuator. **<Countermeasure>** Make sure that the operating conditions are within the specifications. **⚠ Caution** Please refer to the manual or the catalogue of the actuator for the method of operation of the actuator.

Alarm (code)	Teaching box Description	Group	How to deactivate	Alarm contents / Countermeasure
Controller temperture exceeded set range. (1-146)	Over Temp	D	RESET Input SVON (*1)	**<Contents>** The temperature around the power element of the controller is too high. **<Countermeasure>** Make improvements so that the temperature around the controller is kept appropriate.
Controller supply voltage is outside set range. (1-147)	Over Crtl Vol	D	RESET Input SVON (*1)	**<Contents>** The control power supply voltage within the controller is outside the set range. **<Countermeasure>** Make sure that the voltage supplied to the control power (C24V) of the controller is appropriate. **⚠ Caution** If a single power supply is used for both the control power and the motor power, or the power supply is “inrush-current control type” , a power voltage drop may be caused due to a voltage drop during acceleration/ deceleration. **<Contents>** The alarm may be caused by regenerative power depending on the method of operation of the actuator. **<Countermeasure>** Make sure that the operating conditions are within the specifications. **⚠ Caution** Please refer to the manual or the catalogue of the actuator for the method of operation of the actuator.
Current limit is exceeded. (1-148)	Over load	D	RESET SVON Input (*1)	**<Contents>** The output current accumulated value exceeds the specified value. **<Countermeasure>** Check whether the movement of the actuator is obstructed. Also confirm whether the actuator load, speed, acceleration and deceleration are within the specification range of the actuator.
Failed to achieve set position in set time limit. (1-149)	Posn failed	D	RESET Input SVON (*1)	**<Contents>** Failed to reach the set position within the set time limit. **<Countermeasure>** Eliminate any obstructions that interfere with the actuator movement. Also, make sure that the load, speed, acceleration and deceleration are within the range of the actuator.
Communication error. (1-150)	Ctrl Comm ALM	D	RESET Input SVON (*1)	**<Contents>** The connection with the higher-level devices (such as the PC and teaching box) is disconnected. **<Countermeasure>** Make sure that the higher-level devices will not be disconnected during the actuator operation.

Alarm (code)	Teaching box Description	Group	How to deactivate	Alarm contents / Countermeasure
Abnormal absolute encoder (1-152)	AbEnc ALM	D	RESET Input SVON SETUP	**<Contents>** Controller is reset due to descrease in the battery voltage. **<Countermeasure>** If the alarm reoccurs even after supplying power for 72 consecutive hours, replace the battery. **⚠ Caution** This alarm and related alarm (battery voltage decrease alarm) which caused the alarm will be generated.
Absolute encoder ID does not match controller data (1-153)	AbEnc ID ALM	D	RESET Input RESET SVON SETUP	**<Contents>** Data does not match **<Countermeasure>**The alarm related to the cause will be generated after resetting this alarm. Perform countermeasure for each alarm.
Absolute encoder cable is not connected to the controller (1-154)	AbEncCable ALM	D	RESET Input RESET SVON SETUP	**<Contents>** The power has been turned on for the first time after connecting the actuator and the cable. The encoder connector is not connected or the circuit is open. **<Countermeasure>** Confirm that the cable circuit is not open, and the encoder connector is properly connected.
Motor speed was too high when controller power is off. (1-155)	AbEnc overRev	D	RESET Input RESET SVON SETUP	**<Contents>** Actuator was operated with the speed (rotation) exceeding "Maximum cycle of the motor when the power supply is cut". **<Countermeasure>** Do not start actuator with the speed (rotation) exceeding "Maximum cycle of the motor when the power supply is cut". Verify that the period (backup) switch is set correctly.
Absolute power supply voltage fell below set value. (1-156)	Low AbPow Vol	D	RESET Input RESET SVON SETUP	**<Contents>** Absolute power supply voltage fell below set value. **<Countermeasure>** Even after this measure, if the alarm is still generated when the power is reapplied, please contact SMC.

Alarm (code)	Teaching box Description	Group	How to deactivate	Alarm contents / Countermeasure
Encoder error (1-192)	Encoder ALM	E	Power off	**<Contents>** Abnormality in communication with the encoder. **<Countermeasure>** Check the connection of the actuator cable.
Unable to find motor phase in set time. (1-193)	Phase Det ALM	E	Cycle the power supply for the controller	**<Contents>** Unable to find the motor phase within the set time. (When the servo motor is turned on (SVON is turned on) for the first time after the power is applied, the actuator needs to move a little to find the motor phase. However, if this actuator movement is prevented, this alarm will be activated.) **<Countermeasure>** Make sure there are no obstructions that interfere with the actuator movement and then turn on the servo motor (SVON is turned on).
Output current limit is exceeded set value. (1-194)	Over current	E	Cycle the Power supply for the controller	**<Contents>** The output current of the power circuit is abnormally high. **<Countermeasure>** Make sure that there are no short circuits of actuator cables, connectors, etc. In addition, make sure that the actuator is compatible with the controller.
Current sensor abnormality has occurred. (1-195)	I sens ALM	E	Cycle the power supply for the controller	**<Contents>** An abnormality is detected by the current sensor that is checked when the controller is reset. **<Countermeasure>** Make sure that the actuator is compatible with the controller. If the alarm is still generated when the power is reapplied, please contact SMC.
Error counter overflowed.(1-196)	Err overflow	E	Cycle the power supply for the controller	**<Contents>** An overflow of the position error counter inside of the controller has occurred. **<Countermeasure>** Make sure there are no obstructions that interfere with the actuator movement. Also, make sure that the load, speed, acceleration and deceleration are within the range of the actuator.

Alarm (code)	Teaching box Description	Group	How to deactivate	Alarm contents / Countermeasure
Memory Abnormality has occurred. (1-197)	Memory ALM	E	Cycle the power supply for the controller	**<Contents>** An error of the EEPROM has occurred. **<Countermeasure>** Please contact SMC.
CPU error. (1-198)	CPU ALM	E	Cycle the power supply for the controller	**<Contents>** The CPU is not operating normally. (It is possible that the CPU or surrounding circuits has failed, or the CPU is malfunctioning due to electrical noise). **<Countermeasure>** If the alarm cannot be deactivated even after the power is reapplied, please contact SMC.

(*1) Alarm clear method for controller version below SV1.00: input RESET→SVON →SETUP

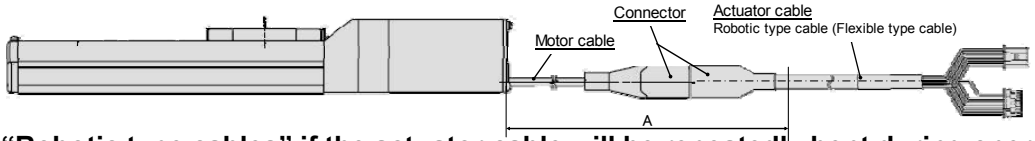
14. Wiring of cables/ Common precautions

⚠Warning

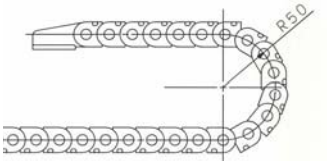
1. **Adjusting, mounting or wiring change should not be done before shutting off the power supply to the product.**
   Electric shock, malfunction and damage can result.
2. **Do not disassemble the cable. Use only specified cables.**
3. **Do not connect or disconnect the cable or connector with the power on.**

⚠Caution

1. **Wire the connector securely. Do not apply any voltage to the terminals other than those specified in the product Manual.**
2. **Wire the connector securely.**
   Check for correct connector wiring and polarity.
3. **Take appropriate measures against noise.**
   Noise in a signal line may cause malfunction. As a countermeasure, separate high voltage and low voltage cables, and shorten wiring lengths, etc.
4. **Do not route wires and cables together with power or high voltage cables.**
   The product can malfunction due to interference of noise and surge voltage from power and high voltage cables to the signal line. Route the wires of the product separately from power or high voltage cables.
5. **Take care that actuator movement does not catch cables.**
6. **Operate with cables secured. Avoid bending cables at sharp angles where they enter the product.**
7. **Avoid twisting, folding, rotating or applying an external force to the cable.**
   There is a risk of electric shock, wire breakage, contact failure and loss of control of the product.
8. **Fix the motor cable protruding from the product in place before using.**
   The motor and lock cables are not robotic type cables and can be damaged when moved. Do not place Part A in the diagram below in a flexible cable duct.



9. **Select "Robotic type cables" if the actuator cable will be repeatedly bent during operation. Do not put cables into a flexible cable duct with a radius smaller than the specified value. (Min. 50mm).**
   There is a risk of electric shock, wire breakage, contact failure and loss of control of the product if "Standard cables" are used in situations where the cables are bent repeatedly.



10. **Confirm proper wiring of the product.**
    Poor insulation (interference with other circuits, poor insulation between terminals etc.) can apply excessive voltage or current to the product causing damage.

11. **The Speed/ pushing force may vary, depending on the cable length, load and mounting conditions etc.**
    If the cable length exceeds 5m, the speed / pushing force will be reduced by a maximum of 10% per 5m. (If cable length is 15m: Maximum 20% reduction.)

[Transportation]

⚠Caution

Do not carry or swing the product by the motor or the cable

15. Electric actuators/ Common precautions

15.1 Design and selection

⚠Warning

1. **Read the Operation Manual before using the product.**
   Handling or usage/ operation other than that specified in the Operation Manual may lead to breakage and operation failure of the product.
   Any damage attributed to the use beyond the specifications is not guaranteed.
2. **There is a possibility of dangerous sudden action by the product if sliding parts of machinery are twisted due to external forces, etc.**
   In such cases, human injury may occur, such as by catching hands or feet in the machinery, or damage to the machinery itself may occur. The machinery should be designed to avoid such dangers.
3. **A protective cover is recommended to minimize the risk of personal injury.**
   If a driven object and moving parts of the product are in close proximity, personal injury may occur. Design the system to avoid contact with the human body.
4. **Securely tighten all stationary parts and connected parts so that they will not become loose.**
   When the product operates with high frequency or is installed where there is a lot of vibration, ensure that all parts remain secure.
5. **Consider a possible loss of power source.**
   Take measures to prevent injury and equipment damage even in the case of a power source failure.
6. **Consider behavior of emergency stop of the whole system.**
   Design the system so that human injury and/or damage to machinery and equipment will not be caused, when it is stopped by a safety device for abnormal conditions such as a power outage or a manual emergency stop of the whole system.
7. **Consider the action when operation is restarted after an emergency stop or abnormal stop of the whole system.**
   Design the system so that human injury or equipment damage will not occur upon restart of operation of the whole system.
8. **Disassembly and modification prohibited**
   Do not modify or reconstruct (including additional machining) the product. An injury or failure can result.
9. **Do not use stop signal,"EMG" of the controller and stop switch on the teaching box as the emergency stop of the system.**
   The stop signal, "EMG" of controller and the stop switch on the teaching box are only to be used for decelerating and stopping the actuator.
   Design the system with a separate emergency stop circuit conforming to relevant safety standards.
10. **When using it for a vertical application, it is necessary to build in a safety device.**
    The rod may fall due to the weight of the work piece.
    The safety device should not interfere with normal operation of the machine.

⚠Caution

1. **Operate within the limits of the maximum usable stroke.**
   The product will be damaged if it is used with a stroke exceeding the maximum stroke. Refer to the specifications of the product.
2. **When the product repeatedly cycles with partial strokes, operate it at a full stroke at least once a day or every 1000 strokes.**

Otherwise, lubrication can run out.

3. **Do not use the product in applications where excessive external force or impact force is applied to it.**
   The product can be damaged. Components including the motor are manufactured to precise tolerances, so even a slight deformation may cause operation failure.
4. **Return to origin cannot be done while operating.**
   It cannot be done during positioning operation, pushing operation and pushing.
5. **Refer to the common precautions for autoswitches (Best Pneumatics No 2) when used with an autoswitch built in.**

15.2 Mounting

⚠Warning

1. **Install and operate the product only after reading the Operation Manual carefully and understanding its contents. Keep the manual in a safe place future reference.**
2. **Observe the tightening torque for screws.**
   Tighten the screws to the recommended torque for mounting the product.
3. **Do not make any alterations to this product.**
   Alterations made to this product may lead to a loss of durability and damage to the product, which can lead to human injury and damage to other equipment and machinery.
4. **When using an external guide, the guide axis should be parallel to the actuator axis.**
   There will be damage/ excessive wear on the lead screw if the external guide is not parallel.
5. **When an external guide is used, connect the moving parts of the product and the load in such a way that there is no interference at any point within the stroke.**
   Do not scratch or dent the sliding parts of the product tube or piston rod etc., by striking or grasping them with other objects. Components are manufactured to precise tolerances, so that even a slight deformation may cause faulty operation.
6. **Prevent the seizure of rotating parts.**
   Prevent the seizure of rotating parts (pins, etc.) by applying grease.
7. **Do not use the product until it has been verified that the equipment can be operated properly.**
   After mounting or repair, connect the power supply to the product and perform appropriate functional inspections to check it is mounted properly.
8. **Cantilever**

   . When the actuator is operated at high speed while it is fixed at one end and free at the other end (flange type, foot type, double clevis type, direct mount type), bending moment may act on the actuator due to vibration generated at the stroke end, which can damage the actuator.

   In such a case, install a support bracket to suppress the vibration of the actuator body or reduce the speed so that the actuator does not vibrate.
9. **When mounting the actuator or attaching to the work piece, do not apply strong impact or large moment.**
   If an external force over the allowable moment is applied, it may cause looseness in the guide unit, an increase in sliding resistance or other problems.
10. **Maintenance space.**
    Allow sufficient space for maintenance and inspection.

15.3 Handling

⚠Warning

1. **Do not touch the motor while in operation.**
   The surface temperature of the motor can increase to approx. 90°C to 100°C depending on the operating conditions. Energizing alone may also cause this temperature increase. As it may cause burns, do not touch the motor when in operation.
2. **If abnormal heating, smoking or fire, etc., occurs in the product, immediately shut off the power supply.**
3. **Immediately stop operation if abnormal operation noise or vibration occurs.**
   If abnormal operation noise or vibration occurs, the product may have been mounted incorrectly. Unless operation of the product is stopped for inspection, the product can be seriously damaged.
4. **Never touch the rotating part of the motor or moving part of the actuator while in operation.**
5. **When installing, adjusting, inspecting or performing maintenance on the product, controller and related equipment, shut off the power supply to each of them. Then, lock it so that no one other than the person working can turn the power on, or implement measures such as a safety plug.**
6. **In the case of the actuator that has a servo motor (24VDC), the "motor phase detection step" is done by inputting the servo on signal just after the controller power is turned on. The "motor phase detection step" operates the table/rod to the maximum distance of the lead screw. (The motor rotates in the reverse direction if the table hits an obstacle such as the end stop damper.) Take the "motor phase detection step" into consideration for the installation and operation of this actuator.**

⚠Caution

1. **Use the controller and actuator combined as delivered.**
   The parameters of each actuator are set before shipment. There is a risk of failure if used in a different combination.
2. **Check the product for the following points before operation.**
   a) Damage to electric driving line and signal lines
   b) Looseness of the connector to each power line and signal line
   c) Looseness of the actuator/cylinder and controller/driver mounting
   d) Abnormal operation
   e) Emergency stop of the whole system
3. **When more than one person is performing work, decide on the procedures, signals, measures and resolution for abnormal conditions before beginning the work. Also, designate a person to supervise work other than those performing work.**
4. **The actual speed of the product may not satisfy the set speed, depending on the load and resistance conditions.**
   Before selecting a product, check the catalog for the instructions regarding selection and specifications.
5. **Do not apply a load, impact or resistance in addition to the transferred load during return to origin.**
   When performing return to origin by pushing force, additional force will cause displacement of the origin position since it is based on detected motor torque.
6. **Do not remove the name plate.**
7. **Operation test should be done at a low speed. Start operation at the predefined speed after confirming there is no trouble.**

[Grounding]

⚠Warning

1. **Ensure the actuator is grounded.**
2. **Class D dedicated grounding should be used.**
   (Grounding resistance 100Ω or less)
3. **Keep the ground wiring length as short as possible.**

[Unpackaging]

⚠Caution

1. Check the received product is as ordered.

If a different product is installed from the one ordered, injury or damage can result.

15.4 Operating environment

⚠Warning

1. Avoid use in the following environments.

a. Locations where a large amount of dust and cutting chips are airborne.

b. Locations where the ambient temperature is outside the range of the temperature specification (refer to specifications).

c. Locations where the ambient humidity is outside the range of the humidity specification (refer to specifications).

d. Locations where corrosive gas, flammable gas, seawater, water and steam are present.

e. Locations where strong magnetic or electric fields are generated.

f. Locations where direct vibration or impact is applied to the product.

g. Areas that are dusty, or are exposed to splashes of water and oil drops.

h. Areas exposed to direct sunlight (ultraviolet rays).

2. Do not use in an environment where the product is directly exposed to liquid, such as cutting oils.

If cutting oils, coolant, or oil mist contaminates the product, failure or increased sliding resistance can result.

3. Install a protective cover when the product is used in an environment directly exposed to foreign matter such as dust, cutting chips and spatter.

Play or increased sliding resistance can result.

4. Shade the product if used in a location exposed to direct sunlight.

5. Shield the valve from radiated heat generated by nearby heat sources.

When there is a heat source surrounding the product, the radiated heat from the heat source can increase the temperature of the product beyond the operating temperature range. Protect it with a cover, etc.

6. Grease/oil can decrease due to external environment and operating conditions, which may reduce the lubrication performance and shorten the life of the product.

[Storage]

⚠Warning

1. Do not store the product in a place in direct contact with rain or water drops orexposed to harmful gas or liquid.

2. Store in an area that is shaded from direct sunlight and has a temperature and humidity within the specified range (-10°C to 60°C and 35 to85%, No condensation or freezing.

3. Do not apply vibration and impact to the product during storage.

15.5 Maintenance

⚠Warning

1. **Do not disassemble or repair the product.**
   Fire or electric shock can result.
2. **Before modifying or checking the wiring, the voltage should be checked with a tester 5 minutes after the power supply is turned off.**
   Electric shock can result.

⚠Caution

1. **Maintenance should be performed according to the procedure indicated in the Operating Manual.**
   Incorrect handling can cause injury, damage or malfunction of equipment and machinery.
2. **Removal of product.**
   When equipment is serviced, first confirm that measures are in place to prevent dropping of work pieces and run-away of equipment, etc, and then cut the power supply to the system.
   When machinery is restarted, check that operation is normal with actuators in the proper positions.

[Lubrication]

⚠Caution

1. **The product has been lubricated for life at manufacturer, and does not require lubrication in service.**
   Contact SMC if lubrication will be applied.

15.6 Precautions for actuator with lock

⚠Warning

1. **Do not use the lock as a safety lock or a control that requires a locking force.**
   The lock used for the product with a lock is designed to prevent dropping of work pieces.
2. **For vertical mounting, use the product with a lock.**
   If the product is not equipped with a lock, the product will move and drop the work piece when the power is removed.
3. **"Measures against drops" means preventing a work piece from dropping due to its weight when the product operation is stopped and the power supply is turned off.**
4. **Do not apply an impact load or strong vibration while the lock is activated.**
   If an external impact load or strong vibration is applied to the product, the lock will lose itsholding force and damage to the sliding part of the lock or reduced lifetime can result. The same situations will happen when the lock slips due to a force over the thurst of the product, as this accelerates the wear to the lock.
5. **Do not apply liquid or oil and grease to the lock or its surrounding.**
   When liquid or oil and grease is applied to the sliding part of the lock, its holding force will reduce significantly.
6. **Take measures against drops and check that safety is assured before mounting, adjustment and inspection of the product.**
   If the lock is released with the product mounted vertically, a work piece can drop due to its weight.
7. **When the actuator is operated manually (when SVRE output signal is off), supply 24DCV to the [BK RLS] terminal of the power supply connector.**
   If the product is operated without releasing the lock, wearing of the lock sliding surface will be accelerated, causing reduction in the holding force and the life of the locking mechanism.
8. **Do not supply 24VDC power supply constantly to the [BK RLS(Lock release)] terminal.**
   Only supply 24VDC power supply to the [BK RLS(Lock release)] terminal during normal operation. If power is supplied to the [BK RLS] terminal continuously, the lock will be released, and workpieces may be dropped at stop (EMG).
   /Refer to the operation manual of LEC (controller) for details of wiring.

16. Precautions of the Absolute Controller

16.1 Handling

⚠ Danger

1) Do not disassemble the battery. Disassembly of the battery may result in a short circuit within the battery pack. Disassembly of the battery can result in heating, explosion or igniting of the battery due to the reaction of the internal substance of the battery with air. Hazardous alkaline liquid will be generated if the battery is disassembled.
2) The battery contains an alkaline liquid. If this liquid comes into contact with the eye, blindness can result. Do not rub the eye, instead, rinse with tap water and seek medical treatment.
3) Do not place the battery in a fire; there is a risk of explosion.
4) Do not place the battery in water, there is a risk that the battery will leak and the performance will deteriorate because of the influence of corrosion and rusting etc.

⚠ Warning

1) Do not use battery when there is leakage, discoloration, or deformation. Heating, explosion or igniting of the battery may result.
2) The battery contains alkaline liquid. If your clothes come into contact with the battery liquid , rinse with tap water to avoid injury to skin.

⚠ Caution

【Long term storage】

1) Long periods of storage of the back up battery can reduce its capacity.
2) Long periods of storage may result in battery leaks and decrease the charge life and performance of the battery.

【Disposal】

1) Do not dispose of used batteries they can be recycled. Apply sealing tape to the connector of the battery for insulation, and treat as recyclable waste. Strictly follow national and local laws and regulations for recycling, collection and disposal of batteries.

16.2 Replacement of Battery

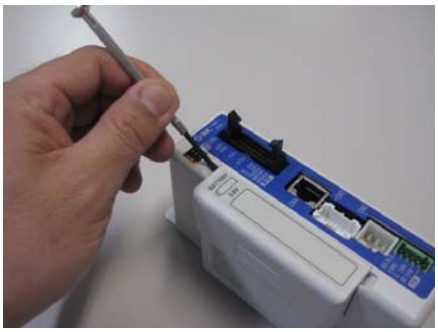
⚠ Caution

The battery is a consumable item.. When it is repeatedly charged and discharged, the initial performance will deteriorate. Please judge the life of the battery, and replace it when hold time shortens significantly.

The standard replacement period for the battery is 2 years from the date of purchase.. Use the purchase date written in the battery case as a guideline for replacement.

It is recommended that the battery is replaced 2 years from the date of purchase.

1） Turn off the controller's power supply after stopping the actuator.
2） Remove the wiring connectors CN1 (Power supply), CN2 (Motor power), CN3 (Encoder), CN4 (Serial I/O) and CN5 (Parallel I/O) from the front of the controller.
3） Detach the battery case installed in the controller.
Use a small flathead screwdriver to lift the battery case out of the controller.



4） Detach the battery connector from the controller PCB.

5） Change the battery and install it into the case.
6） Connect the battery to the connector on the controller PCB.

7） When installing the battery case, ensure that the cable is not trapped between the battery case and the controller housing.

8） Carefully push the battery case into the controller housing until fully installed.
Confirm that the battery case does not move.

9） Reconnect the wiring connectors removed in note 2): CN1 (Power supply), CN2 (Motor power), CN3 (Encoder), CN4 (Serial I/O) and CN5 (Parallel I/O) into the front of the controller.
10）Turn on the controller's power supply, and execute alarm reset.
11）Charging of the battery begins (72 hours charge time). Refer to “8.1 Charging of the battery”.

17. Controller and Peripheral Devices/ Specific Product Precautions

17. 1 Design and selection

⚠Warning

1. Ensure that the specified voltage is applied.

Otherwise, malfunction and damage to the controller may result.

If the applied voltage is lower than the specified voltage, it is possible that the load cannot be moved due to an internal voltage drop. Check the operating voltage before use.

2. Do not operate beyond the specifications.

Fire, malfunction or actuator damage can result. Check the specifications before use.

3. Install an emergency stop circuit.

Install an emergency stop outside of the enclosure so that it can stop the system operation immediately and intercept the power supply.

4. Establish a back up system such as multiple system of equipment and devices or fail safe design in advance.

5. If fire or personal injury is expected due to abnormal heat generation, ignition, smoking of the product, etc., cut off the power supply for this product and the system immediately.

17. 2 Handling

⚠Warning

1. The inside of the controller and its connector should not be touched.

It may cause an electric shock or damage to the controller.

2. Do not perform the operation or setting of this equipment with wet hands.

It may cause an electric shock.

3. A product that is damaged or missing any components should not be used.

It may cause an electric shock, fire, or injury.

4. Use only the specified combination of controller and electric actuator.

It may cause damage to the controller or the actuator.

5. Be careful not to be caught or hit by the workpiece while the actuator is moving.

It may cause an injury.

6. Do not connect the power supply or power to the product until it is confirmed that the area where the workpiece moves is safe.

The movement of the workpiece may cause an accident.

7. Do not touch the product when it is energized and for some time after power has been disconnected, as it is very hot.

It may cause burns due to the high temperature.

8. Before modifying or checking the wiring, the voltage should be checked with a tester 5 minutes after the power supply is turned off.
There is a possibility of electric shock, fire and injury.

9. Do not use in an area where dust, powder dust, water or oil is in the air.
It will cause failure or malfunction.

10. Do not use in an area where a magnetic field is generated.
It will cause failure or malfunction.

11. Do not install in an environment containing flammable gas, corrosive gas or explosive gas.
It could lead to fire, explosion and corrosion.

12. Do not subject the product to radiant heat from strong heat supplies such as a furnace, direct sunlight, etc..
It will cause failure of the controller or its peripheral devices.

13. Do not use the product in an environment subject to a temperature cycle.
It will cause failure of the controller or its peripheral devices.

14. Do not use in a place where surges are generated.
When there are units that generate a large amount of surge around the product (e.g., solenoid type lifters, high frequency induction furnaces, motors, etc.), this may cause deterioration or damage to the product's internal circuit. Avoid surge generation and crossed lines.

15. Do not install this product in an environment subject to vibration and impact.
It will cause failure or malfunction.

16. If this product is used with a relay or solenoid valve, they should be the surge absorbing element built-in type.

17. 3 Installation

⚠Warning

(1) The controller and its peripheral devices should be installed on a fire-proof material.
Direct installation on or near a flammable material may cause fire.

2. Do not install this product in a place subject to vibration and impact.
Malfunction or failure can result.

3. Take measures so that the operating temperature of this controller and its peripheral devices are within the range of the specifications.
Also, this controller should be installed with at least 50mm space between each side of it and other structures or components.
It may cause a malfunction of the controller and its peripheral devices and a fire.

4. Do not mount this controller and its peripheral devices together with large electromagnetic contactor or no-fuse breaker, which generates vibration, on the same panel. Mount them on different panels, or keep the controller and its peripheral devices away from such sources of vibration.

5. This controller and its peripheral devices should be installed on a flat surface.
If the mounting surface is distorted or not flat, excessive force may be applied to the housing, etc. causing malfunction.

17. 4 Wiring of cables/ Common precautions

⚠Warning

1. Do not apply excessive force to cables by repeated bending, tension or placing a heavy object on the cables.
It may cause an electric shock, fire, or breaking of wire.

2. Connect wires and cables correctly.
Incorrect wiring could break the controller or its peripheral devices depending on the seriousness.

3. Do not connect wires while the power is supplied.
It can break the controller or its peripheral devices could be damaged, causing malfunction.

4. Do not carry this product by holding its cables.
It may cause an injury or damage to the product.

5. Do not connect power cable or high-voltage cable in the same wiring route as the unit.
The wires to the controller or its peripheral devices can be interrupted with noise or induced surge voltage from power lines or high-voltage lines, causing malfunction.
Separate the wiring of the controller and its peripheral devices from power lines and high voltage lines.

6. Verify the insulation of wiring.
Insulation failure (interference with another circuit, poor insulation between terminals etc.) could introduce excessive voltage or current to the controller or its peripheral devices and damage them.

17. 5 Power supply

⚠Caution

1. Use a power supply that has low noise between lines and between power and ground.
In cases where noise is high, an isolation transformer should be used.

2. The power supplies should be separated between the controller power and the I/O signal power. For both of them, do not use “inrush-current control” type.

If the power supply is “inrush-current control”, a voltage drop may be caused during the acceleration of the actuator.

3. Take appropriate measures to prevent surges from lightning. Ground the surge absorber for lightning separately from the grounding of the controller and its peripheral devices.

17. 6 Grounding

⚠Warning

1. Ensure that the product is grounded to allow the noise tolerance of the controller.
Otherwise it may cause an electric shock or fire.

2. Dedicated grounding should be used.
Grounding should be to a D-class ground. (Ground resistance of 100Ω or less)

3. The grounding point should be as near as possible to the controller to keep the cable length short.

4. In the unlikely event that malfunction is caused by the ground, it may be disconnected.

17. 7 Maintenance

⚠Warning

1. Perform maintenance checks periodically.
Confirm wiring and screws are not loose.
Loose screws or wires may cause unexpected malfunction.

2. Conduct an appropriate functional inspection after completing the maintenance.
In case of any abnormalities (if the actuator does not move, etc.), stop the operation of the system.
Otherwise, an unexpected malfunction may occur and it will become impossible to ensure safety.
Give an emergency stop instruction to confirm safety.

3. Do not disassemble, modify or repair this controller and the peripheral equipment.

4. Do not put anything conductive or flammable inside of this controller.
Burning or explosion can result.

5. Do not conduct an insulation resistance test and withstand voltage test on this product.

6. Ensure sufficient space for maintenance.
Design the system allowing the required space for maintenance.

18. Troubleshooting

Refer to the table below for troubleshooting. When none of the causes in the troubleshooting can be confirmed and normal operation is recovered by the replacement of the product, it is presumed that failure is in the product.

It is possible that this product may be damaged due to the operating conditions (application).,

Please contact SMC to discuss appropriate measures.

18. 1 Operation problems

Problem	Possible cause	Investigation method and location of possible causes	Countermeasures
The actuator does not move at all.	Power fault	Check if the LED (green) of the controller is on.	Check the power supply, voltage or current to the controller. →4. External Wiring Diagram →5. CN1: Power supply plug
	External device fault	Check if the PLC connected to the controller is working well. Test operation of the controller on its own.	Take appropriate measures according to this manual. → 6.3 Parallel I/O cable wiring details for controller CN5 connector to PLC
	Wiring fault	Check if the controller is wired correctly according to this manual without any broken wires and short circuits.	Correct the wiring so that the input/output of each signal is performed appropriately. Separate the power supply for the CN1controller power supply and the CN5 I/O signal power supply. → 4. External Wiring Diagram →6.4 Parallel I/O Wiring Example
	Alarm condition	Check if the controller is in the alarm condition. If it is, check the type of alarm referring to this manual.	Take appropriate measures according to this manual. → 13. Alarm Detection
	Lock release error	Check if you can hear the sound of lock release when the manual lock switch is turned on and off.	If there is no sound of lock release, the lock brake may be broken. → If the problem persists, please contact SMC.
	Inappropriate specifications	Check if the controller's specifications are appropriate, the power supply is suitable and the actuator is compatible with the controller.	Check the actuator part number and confirm it is compatible with the controller. → 3. Product Specifications

Problem	Possible cause	Investigation method and location of possible causes	Countermeasures
. Operation stops intermittently	Alarm condition	Check if the controller is in the alarm condition. If it is, check the type of alarm referring to this manual.	Take appropriate measures according to this manual. →13. Alarm Detection
	Wiring fault	Check if the controller is wired correctly according to this manual without any broken wires and short circuits.	Correct the wiring so that the input/output of each signal is performed appropriately. Separate the power supply for the CN1controller power supply and the CN5 I/O signal power supply. →4. External Wiring Diagram →6.4 Parallel I/O Wiring Example
	Electric noise	Check if the grounding for the controller is appropriate. Also, check the cables are not bundled.	Take appropriate measures according to this manual. → 3.4 How to install
	Inappropriate parameter	Check if the parameters are appropriate. Check if the controller is compatible with the actuator.	Modify the parameters accordingly and check the operation. → 7. Setting Data Entry
	Voltage drop	Check if there are any temporary voltage drops in the power supply. (In case of a voltage drop, the EMG terminal of CN1 power connector will be turned off to put the actuator in a stop condition. However, this stop will be released when the voltage recovers.)	There is a possibility of a momentary voltage drop because the capacity of the power supply is insufficient, or if the power supply is “inrush-current control” type. If necessary, replace the power supply. → 3. Product Specifications
	Failure of pushing operation.	Check whether the INP output turns on during pushing operation. (If completion of pushing operation is detected by the INP outputl, the PLC cannot confirm the completion of driving.)	If the controller version is below SV1.00, the pushing force decreases when the energy saving mode is turned on. If the pushing force is reduced to a value less than the value in step data “trigger LV” the INP output signal is turned off. Check the INPoutput signal before the energy saving mode is turned on. → 6.3 Parallel I/O cable wiring details for controller CN5 connector to PLC
	Inappropriate specifications	Check if the controller’s specifications are appropriate, the power supply is suitable and the controller is compatible with the actuator.	Check the actuator part number and confirm it is compatible with the controller. → 3. Product Specifications
	Signal timing	Check the timing of the signal from the PLC to the controller.	PLC processing delay and controller scan delay are generated. Please ensure an interval of 15ms(30 ms if possible) or more between input signals, and maintain the signal state. → 9.4 Controller input signal response time

Problem	Possible cause	Investigation method and location of possible causes	Countermeasures
Communication fault(LEC-W2).	USB driver is not installed	Please confirm if the USB driver of the communication unit is installed.	Please install the USB driver of the communication unit. The USB driver's installation starts when the communication unit is connected with PC. Details of the installation procedure are shown in "Installation procedure of the LEC-W2 setting software".
	Incorrect COM port setting	Please confirm if the correct COM port is set to the ACTController	The COM port allocated to the communication unit is different according to customer's PC. Please confirm the COM port number with the PC communication unit connected. The COM port number can be checked by checking Device Manager in PC. Details of the COM port checking method and setting method are shown in "Installation procedure of the LEC-W2 setting software".
	Inappropriate connection	Please confirm the connection status.	Please confirm motor controller (LEC) = communications cable = communication unit = USB cable = PC is connected. Communication cannot be established if the connectors are damaged. Please confirm the power supply of motor controller (LEC) has been turned on. Communication cannot be establishedif the Power supply is off. If equipment other than the motor controller (LEC) (PLC and measurement equipment) is connected with PC, remove these before checking. (There is a possibility that the communication with other equipment interferes in PC.)

18. 2 Position / Speed problems

Problem	Possible cause	Investigation method and location of possible causes	Countermeasures
The actuator does not move to the correct position.	Incorrect origin position	If it is a pushing operation, repeat return to origin operations several times to check if the actuator returns to the origin correctly.	Take measures to make the actuator operate normally (remove foreign matter that interferes with the actuator movement, etc.)
	Inappropriate basic parameters	Check if the values for the parameter are appropriate and the program is correct. Review the maximum speed, the maximum acceleration and the maximum deceleration of the actuator.	Modify the parameters and test the operation. → 7. Setting Data Entry
	Inappropriate specifications	Check if the controller's specifications are appropriate, the power supply is suitable and the controller is compatible with the actuator.	Take appropriate measures according to this manual. → 3. Product Specifications
The actuator does not move correctly.	Wiring fault	Check if the controller is wired correctly according to this manual without any broken wires and short circuits	Correct the wiring so that the input/output of each signal is performed appropriately. Separate the power supply for the CN1 controller power supply and the CN5 I/O signal power supply. → 4. External Wiring Diagram →6.4 Parallel I/O Wiring Example
	Inappropriate specifications	Check if the controller's specifications are appropriate, the power supply is suitable and the controller is compatible with the actuator.	Take appropriate measures according to this manual. → 3. Product Specifications
	Signal timing	Check the timing of the signal from the PLC to the controller.	PLC processing delay and controller scan delay are generated. Please ensure an interval of 15ms(30 ms if possible) or more between input signals, and maintain the signal state. → 9.4 Controller input signal response time
	Data writing failure	Check whether data (step data, parameter) is written correctly. Do not turn off the controller input power or remove the cable while data is being written (green light flashing).	Input correct data (step data, parameter) again and confirm operation. → 3.2 Parts description → 7. Setting Data Entry

Problem	Possible cause	Investigation method and location of possible causes	Countermeasures
Insufficient speed	Inappropriate basic parameters	Check if the values for the parameter are appropriate and the program is correct. Review the maximum speed and the maximum acceleration of the actuator.	Modify the values of the parameters and test the operation. → 7. Setting Data Entry
	Inappropriate step data	Check if a trapezoidal acceleration / deceleration is programmed for the actuator operation. In case of such operation, the actuator may start slowing down before it reaches the maximum speed.	Modify the setting to make the moving distance longer or the acceleration larger. → 7. Setting Data Entry
	Inappropriate specifications	Check if the controller's specifications are appropriate, the power supply is suitable and the controller is compatible with the actuator.	Take appropriate measures according to this manual. → 3. Product Specifications
	Voltage drop	Check if there has been any temporary voltage drop in the power supply. (If there is a temporary voltage drop in the power supply, the EMG terminal of CN1 power connector will turn OFF so the actuator will stop. However, this stop will be released when the voltage recovers.)	There is a possibility of a momentary voltage drop because the capacity of the power supply is insufficient, or if the power supply is "inrush-current control" type. If necessary, replace the power supply. →3. Product Specifications

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